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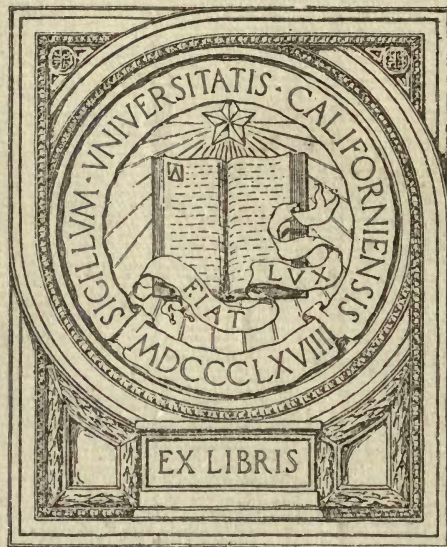
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THE FILE IN HISTORY



Henry Disston & Sons
Incorporated
Keystone Saw, Tool, Steel and File Works
PHILADELPHIA

THE FILE

Its History, Making, and Uses



A description of the development of the file from the earliest times to the present day; a brief statement of the modern method of file making; a description of the great variety of files and the numerous uses to which the tool is adapted.



It is hoped that those who read this description of the development and uses of the file will come to appreciate better the importance of the tool and to value it more highly.

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HENRY DISSTON & SONS INC.

Keystone Saw, Tool, Steel, and File Works

PHILADELPHIA, U. S. A.

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HENRY DISSTON

“**H**E created a new American industry. He gave to the United States the greatest saw works in the world, and thus founded an industrial university wherein a dozen useful trades are taught. Not only did he redeem us from all dependence on foreign countries, but turned back the tide and made them accept his products, and this simply by peaceful demonstration of superior skill in manufacturing.”

FOREWORD

There are few tools more essential in the development of industry than the file. Perhaps for the very reason that it is so universally used and so absolutely indispensable, the file does not commonly receive the attention it deserves, as a tool, from craftsmen and students.

This book is dedicated to those innumerable men to whom the file is an everyday friend and a necessity—the tool which enables them to do more and better work with less labor.

There has been no guide for the compilation of the material in this book. Information has been obtained from every available source. It is possible, therefore, that the wide circulation of the book will bring to light some omissions, which, we hope, will be passed with tolerance in view of the difficulties attending the compilation of the facts.

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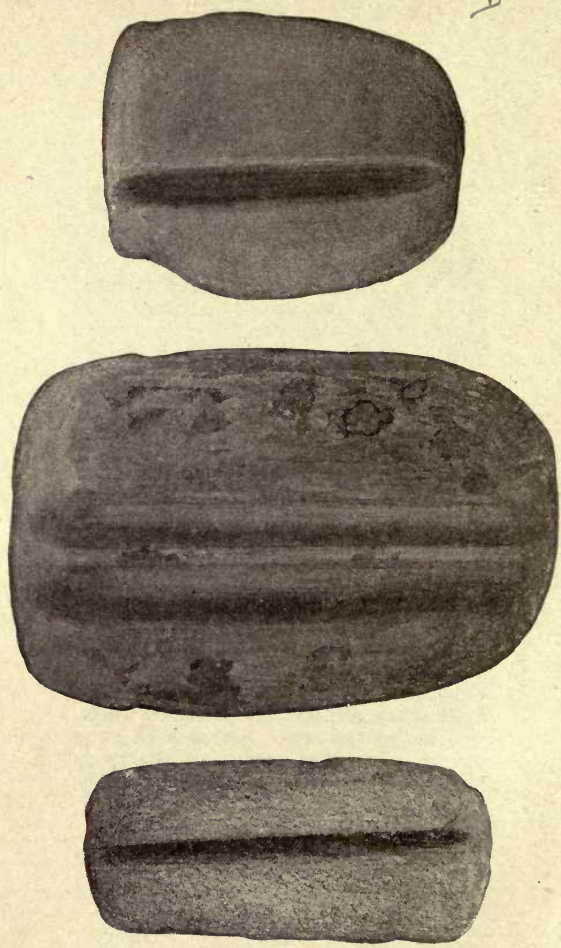


Fig. 2

STONES USED BY ANCIENT PUEBLO INDIANS FOR
POLISHING AND STRAIGHTENING ARROW SHAFTS

(See Page 6)

THE FILE

ITS HISTORY, MAKING, AND USES

ALTHOUGH the history of the file can be traced back into the remote past, its age is by no means as great as the saw. Scientists believe, in fact, that the artificial file was a natural development from the saw, the notched edges of stone and metal implements leading to the invention of a tool having teeth for abrasive purposes.

Abrading instruments, while dating from many centuries before Christ were at first composed of some natural substance which might be said to have ground off the surface rather than to have cut it, as do the files and rasps of today.

As in many other things, Nature herself has taken precedence over man in the origination of files. There is a type of mollusc having a rough tongue with which it rubs or files through the shells of other molluscs on which it feeds. The wasp, also, has a rasp-like organ with which it abrades dry wood, afterwards mixing the dust with a glutinous saliva to form the paper from which it builds its nest. The cat's tongue, and that of the cow, are familiar examples of abrading organs in the animal kingdom.

Prehistoric man made handles for his weapons by sawing or splitting wood, rough-shaping the pieces as well as he could by primitive methods, and finally finishing and polishing them by means of the particular abrasive material found in his vicinity. A remarkable connection between these ancient times and the most modern, is found in the present-day use of sandpaper and emery cloth. These are only a modified form of the first stone abrading

instruments used by primitive man, proving that many of our primordial instincts are still existent. There are few of us, in fact, who have not, at some time in our lives, scraped up sand with a shell, or used a stone to drive a nail—both survivals of the Stone Age, and illustrating man's intuitive employment of the things Nature placed ready to his hand.

To abrade, or file, ancient man used sand, grit, coral, bone, fish skin, and gritty woods,—also stone of varying hardness in connection with sand and water.

Crude as were these abrading instruments, and slow and laborious as must have been their use, they nevertheless served primeval man well throughout the Stone and Bronze Ages. Up to the time of the discovery of iron, natural abrasives were used extensively. Copper, and later, bronze, did not permit of sufficient hardening to be used as a material for the making of artificial files, although attempts were made to use both for that purpose.

M. Adrien de Mortillet, in his classification of prehistoric tools, gives first place to cutting tools, and second to rasping tools, which, of course, include the file and rasp, thus showing the importance of the file since earliest times. And yet, with its important standing, there is a remarkable scarcity of both history and relics as compared with other examples of the handiwork of man.

Strange as it may seem, the North American continent has yielded more examples of the natural files of the ancients than any

other part of the globe. Among the Mound Builders and Cliff Dwellers of America, those ancient and prehistoric peoples of whose coming and going so little is known, stones were used for abrading purposes. Although both races left traces of their familiarity with certain kinds of metal, from which they made tools, ornaments; and other articles, neither race, apparently, was acquainted with the artificial file. Nothing of the kind has ever been found, so far as is known, but several examples of the stone-file have been unearthed.

Fig. 1 shows one of these stones which was found in a Mound Builders' cemetery in Tennessee. From the peculiar grooves in this stone it would appear that it had been used for smoothing arrow shafts.

Early Indians Used Abrasive Tools

The ancient Pueblo Indians, who inhabited the Calisteo Basin in Western North America, left, among many other crude tools and pieces of pottery, specimens of stone which archæologists say were also used to smooth and polish arrow shafts. Some of these are preserved in the American Museum of Natural History in New York. Three good examples of these stones are shown in Fig. 2 (frontispiece). The material appears to be soft sandstone, of varying grades of fineness, in which deep grooves have been worn by drawing them along the wooden shafts. As proof of this use, it may be said that Eskimos of the Arctic regions today use stones to smooth and sharpen their spear-heads. Captain George Comer while on an expedition in the far north secured a specimen of stone, pictured in Fig. 3, which was used like a file by the natives. It measures about eight

inches in length, one and a half inches in width, and three-quarters of an inch in thickness.

It is discoveries such as this that have greatly aided scientists in unraveling the tool mysteries of the earth's early inhabitants. In fact, study of the customs and tools of the savages of today give a very clear idea of the tools used, and the manner of making those tools, in prehistoric times. The South Sea Islanders, for instance, aptly illustrate this,—for, in these days of wonderful tool development, they are still using pieces of coral as rasps.

The remarkable resemblance between the tools used in bygone ages in different parts of the earth, and by dissimilar peoples, occasioned much comment in the past, but the modern scientist has realized that, as Major Powell, the great ethnologist, once said: "The mind of man is everywhere the same; the difference of its products are evidences of differences of growth, or different conditions of environment." In other words, man's progress has depended solely upon his needs and what was at hand to progress with. His inventive tendencies, once aroused, developed along parallel lines—limited only by the material and facilities for carrying them out. Implements are more or less alike because man's

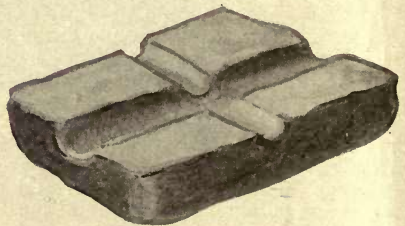


Fig. 1.—Filing stone from the Mound Builders' Ruins in Tennessee.

needs are alike. This in itself would cause a similarity of tools the world over.

In spite of a civilization claimed to antedate that of the East, the development on the Western Hemisphere in ancient times did not

used, many still clung to their stone tools. This is believed to have been especially so with the poorer classes who could not afford the more costly metal implements. Indeed, it is well known that in the mines of Spain and Sardinia stone ham-

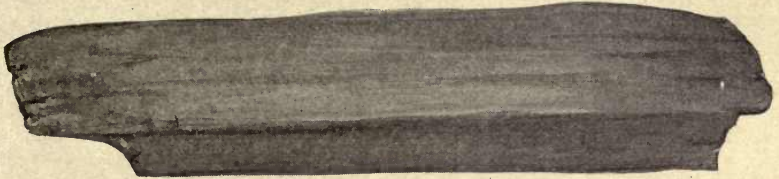


Fig. 3.—Stone used as a file by the Nectchillic Eskimos

seem to go beyond a certain point. So, while we find the earliest specimens of the file on the American continent, we must turn to the Eastern countries for the beginning of what we have termed the artificial file.

Evolution Of The Ages

The Stone Age, with its natural files, slowly gave way to the Age of Copper, and this in turn to the Bronze Age. Tools, weapons, and other articles found a wider development with the coming of these metals, but, as stated before, the file is a tool of exceedingly rare occurrence in copper or bronze, though not absolutely unknown in deposits belonging to the close of the Bronze Age. It is sometimes difficult to place the dates or ages of many stone and metal implements found among the ancient remains, for Europe remained far behind Asia in this particular for many years. In 2500 B. C., while all Asia shared in the knowledge of Bronze, Europe was still in the Stone Age. Then, too, long after metal was fairly well known and

mers were in use during historic times.

Of prehistoric files recovered, the greater number have been of bronze from the "hoards" of that period. A "hoard" is a deposit or collection of bronze objects. Investigators have found them in many places all over Europe—several ancient cemeteries appearing to have been favorite hiding places.

The theory of these "hoards" is that they were used as storage places, and were sometimes the property of individuals, sometimes of traders, and sometimes of bronze founders. The latter surmise is derived from the fact that many of the "hoards" contained broken and worn tools, lumps of metal, and moulds for casting, as well as numerous perfect tools.

In a prehistoric cemetery at Hallstatt, in upper Austria, an implement of a very hard grayish alloy was found. This was believed to have been an anvil, and with it was found a bronze file. In fact, several files of bronze, and one of iron, have been found in this same cemetery. The bronze files are from five to ten inches long. A few of these, while flat for the greater part of

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their length, are drawn down for about two inches at the end into tapering round files. In a "hoard" found in Bologna were several fragments of files, including one of a half-round file.

Sir William Wilde states that he found among a collection of bronze tools in the Museum of the Royal Irish Academy, a "bronze circular file, straight, like a modelling tool."

The early form of file is much the same as that of a very broad saw, the toothing coarse, and run-

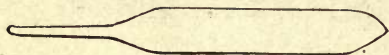


Fig. 4.—File from the prehistoric lake-dwellings of Switzerland.

ning at right angles across the blade. A very good illustration of this is the iron file found in the remains of prehistoric Lake-Dwellings in Switzerland. Fig. 4, giving an outline of this file, is taken from Munro's "Lake-Dwellings of Europe." Note the well-defined tang.

With the ancients, Crete was famed for the skill of its people in working metal. It had become a well-known art there before the people of the North knew anything of metal. Among the earliest known examples of the artificially made abrading instruments of metal, for which a date can be fixed, is a bronze file (see Fig. 5) which was dug up in Crete by an expedition from the University of Pennsylvania, and is now in the Museum at Candia. This file has a rounded back and a flat surface for rubbing. The astonishing likeness to the half-round file of today will be noticed at once. It is believed to have been made about 1500 B. C. Its length is $3\frac{5}{8}$ inches, width $\frac{3}{8}$ of an inch, and thickness $\frac{1}{4}$ of an inch.



Fig. 5.—Ancient bronze file from Crete.

Rasps Used 1200 Years B. C.

The Egyptians of the Lisht Dynasty, about 1200 to 1000 B. C., made small rasps of bronze, as several specimens have been found which could be more or less accurately connected with that time. These rasps are shown in Fig. 6. They are $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length, and appear to have been made from sheet bronze. Holes were punched through the metal with a sharp-pointed instrument. It was then coiled into the form of a cone-shaped cylinder with the rough edges or projections of the holes on the outside. These acted as the teeth. It is uncertain what these crude rasps were used for. The softness of the material must have made their use extremely limited. Some suggestion, however, may be obtained from another rasp

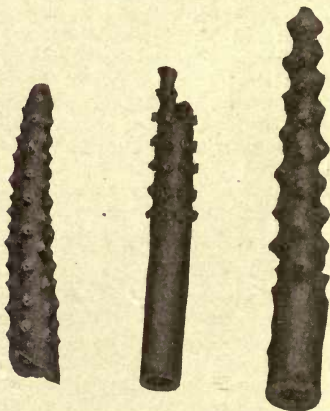


Fig. 6.—Bronze rasps used by the Egyptians 1200-1000 B. C.

of a somewhat similar nature which was found in the Rammesseum in Egypt. This little rasp, about two inches long, and a half inch thick at the base, is made out of sheet copper with holes punched as previously described. In fact, reference to Fig. 7 will show that these rasps, found at different times and places, are very much alike. As

is found in I Samuel: XIII: 21, which is supposed to relate to about the year 1093 B. C. This reads:

"They had a file for the mattocks, and for the colters, and for the forks, and for the axes, and to sharpen the goads."

The word "file" here is the incorrect rendering of "petsirah pim," which means notching of the mouth



Fig. 7.—Copper rasp found in the Rammesseum, Egypt.

the Egyptians in the Rammesseum used to work in gold it may safely be surmised that this little rasp was probably used in a manner similar to the jewelers' rasp of today. The rasp shown in Fig. 7 is now in the Museum of the University of Pennsylvania.

These rasps may have had a wooden handle inserted in them. While no trace of such handles was found, this supposition arises from the curious resemblance between these rasps and those made by the American Indian of more or less modern times which will be described later. As the Bronze Age is believed to have been at its height about 4000 years before the Christian Era, we may safely assume that bronze files were in use long before these specimens just described.

That there were iron files in Solomon's time may be inferred from his statement: "Iron sharpeneth iron; so a man sharpeneth the countenance of his friend," but the first historical mention of artificial files that can be definitely identified as referring to such implements as are now understood by this term

or edge of tools, i. e., to remove the bluntness or dullness (and so sharpen the edge) of these agricultural implements by abrasion in consequence of the lack of smiths to sharpen them by forging out the points.

Files are also mentioned in Homer's *Odyssey*. They were doubtless very crude in form and inefficient in operation as compared to present-day files, but the fact that they were mentioned in these early writings is proof that they were held in high esteem by workmen of ancient times.

As both of these citations refer distinctly to the use of files in metal working, it is quite apparent that the ancients knew how to make use of these tools for much the same purposes as they are most frequently employed today, viz., the fitting and finishing of metal work. Wood finishing, as practiced by prehistoric man, and his immediate successors, was easily accomplished by the use of natural abrasives, but cutting implements with sharp teeth were required when tools and weapons came to be constructed of iron.

Evidence Of Iron In The Early Ages

The date at which iron first became known to the early races of man is still a matter of dispute. A Chinese, Fuh-he, records in that extraordinarily ancient volume, the "Book of Historical Documents," that he accidentally smelted iron when clearing forests about 3200 B. C. The blue color used in depicting knife blades in drawings on the tombs at Thebes, Egypt, would seem to indicate that it was known among the Egyptians as early as 1565 B. C. Remarkably fine specimens of early iron work, however,



Fig. 8.—Assyrian file, made in the 7th Century, B. C.

have been taken from the ruins of Memphis and Thebes. As these cities are so old that their origin is lost in the remote past, the knowledge and use of iron might even have existed at a much earlier period. The Greeks are supposed to have known iron before the foundation of Troy in 1537 B. C. Their poetry, fables, and mythology contain many references to iron. Homer tells us that at the siege of Troy the leaders and great heroes carried swords of bronze, while the common soldiers were armed with iron weapons. In spite of the fact that the Greeks are supposed to have known and worked in iron before the foundation of Troy, Dr. Schliemann, in his book "Illios," claims that files were not used in the cities of Troy and Mycenae. During all his explorations he found absolutely no trace of them at these places. We read that David, about a thousand years before the Christian Era, "prepared iron in abundance for the building of his temple."

That the people of India knew of iron at an exceptionally early date is proved by their skill in working the metal long before the Christian Era. At one of the gates of the temple of Katub, near Delhi, is a wrought iron pillar 23 feet 8 inches high above the ground. Its total height, however, is believed to be about 60 feet. It is 16.4 inches across at the base and 12.05 inches at the top. Its weight is estimated at seventeen tons. A Sanskrit inscription places the date of its erection in the tenth century before Christ. While no definite date can be set, it is certain that the knowledge of the manufacture of iron spread from Asia into Europe.

Daimachus, a writer who was contemporary with Alexander the Great (about 300 B. C.), enumerates four different kinds of steel and their uses. The Chalybdic, Synopic, Lydian, and Lacedaemonian. From the latter, he states, were made files, augers, chisels, and stone-cutting implements.

The crucible method of melting steel is one of the oldest forms of melting iron and steel, being mentioned in all early writings.

As a matter of fact, the possession of iron weapons among nearly all the races at this early time would suggest the use of iron or steel abrading instruments in their manufacture, but no examples can be found. Even though they had existed, it is highly probable that the oxidizing action of the elements would have destroyed them during such a long lapse of years. There is no doubt that the great bulk of the objects of iron belonging to antiquity have totally disappeared. In proof of this disappearance of iron and steel relics may be mentioned numerous cases where the gold ornamentations of iron and steel swords and helmets have been unearthed while the sword or hel-

met itself is only represented by a slight trace of rust. Only in those parts of the world where an extremely dry, sandy soil existed can we find any relics. And even when these are found, they have, in many cases, become so thoroughly oxidized that they crumble to pieces on coming into contact with the air.

We touch at some length and detail upon iron because the real beginning of the modern file and rasp, like many other things, must have had its inception in this metal. Yet with the beginning of the use of iron and steel for the making of files, both records and relics almost disappeared. The file by that time had become such an everyday tool among artisans that few, if any, writers thought it worthy of special mention. At the same time, the well-known corrosive qualities of these metals, which we have just touched on, gradually eliminated practically all the early examples of this kind of file.

First Iron Rasp Made By Assyrians

The Assyrians, who were about the first race to profit by the discovery of iron, made a straight rasp of iron of which an excellent ex-

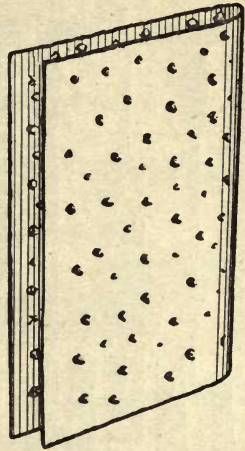


Fig. 9.—Indian rasp for smoothing arrow shafts.

were in their tool making is further proved by the investigations in Egypt of Prof. Flinders Petrie. In one of his books on that country, he says:

"A set of iron Armourers' tools was found at Thebes with a copper helmet of Assyrian form, and therefore probably left by the expedition under Asshur-bani-pal in 666 B. C. These tools comprise flat chisels,

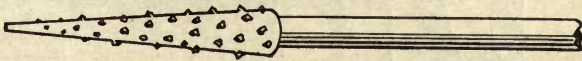


Fig. 10.—Indian rasp for boring out cane.

ample has been found. Reference to Fig. 8 will show that the form is exactly like that of modern times. As this rasp definitely dates back to the seventh century, B. C., it will be seen how clever the ancients were in originating tools which have preserved their essential form down to the present day.

How clever the Assyrians really

mortise chisels, saws, a punch, a rasp, a file, a twist scoop, and two center-bits. The forms of most of these tools have already attained to the modern types; but the file is only slight and irregular, and the center-bits are only fit for hard wood. The edges of these tools are of steel, probably produced by case-hardening the iron."

Early Uses Of Tools



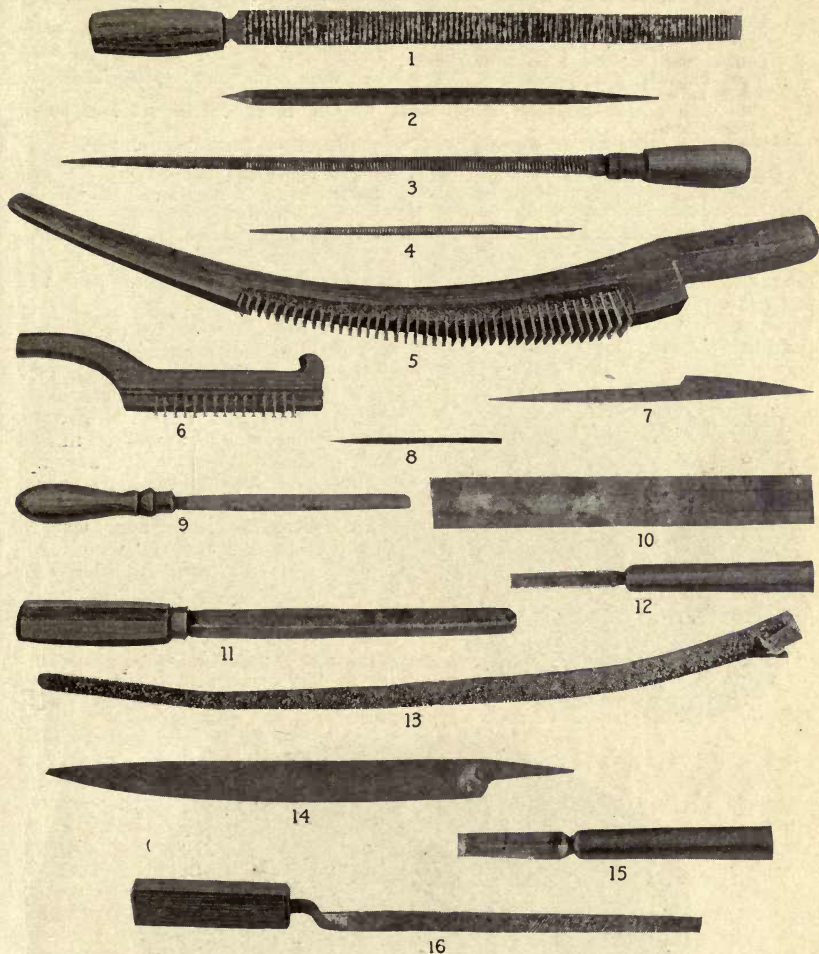
Fig. 11.—Examples of primitive files.

To illustrate the workings of the primitive mind in various parts of the world at different times, and to give an insight into the methods probably in use in very ancient times, of which neither history nor relics tell anything, we picture in this article several peculiar forms of files that are connected with quite modern times. In Fig. 9 is shown a rasp used by the American Indians in making arrow shafts, etc. This rasp, which is in the Museum of the University of Pennsylvania, was obtained by them from the Indians in 1908. It had been in use for a considerable period. The rasp is made of a piece of sheet iron with holes punched through. The sheet was then bent over like a book cover, with the rough edges of the holes on the inside. The article to be filed was run through the interior. The use of sheet iron has only been known to the Indians for about eighty or ninety years, so it will be seen that this rasp is comparatively modern.

The Indians of later times made a blow gun out of a species of cane which much resembled bamboo. To clear these out and smooth the joints they had a special form of rasp (see Fig. 10) mounted on a long thin stick. This rasp, too, was made by punching holes in a piece of tin with a sharp instrument, and then coiling the tin in a conical form somewhat similar to that of the ancient Egyptians, as illustrated in Figs. 6 and 7 on pages 8 and 9. As the Indians could have no knowledge of the methods used by the Egyptians several thousand years ago, the similarity in these rasps is striking.

Belden, in his book, "The White Chief," gives several interesting

Fig. 12.



1. Heavy rasp, blade 13 inches long, 1 inch wide. China.
2. Square file, 11 inches long, 5/16-inch square, cross cut on all four sides. China.
3. Pointed rasp with a curved face. Blade 14 inches long. China.
4. Smaller rasp, blade 7 inches long, cross section elliptical, but cut on only one side. China.
5. Heavy wood rasp. Made of wood with 42 steel blades set into it. China.
6. Smaller wood rasp. Same character but with only 15 blades set in a straight surface. China.
7. Knife-shaped file. The wide end is finely cross cut on both sides. The narrow

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- end is flat on one side and curved on the other, cross cut on both surfaces. China.
8. Small file. Blade only two inches long, one side flat, the other curved, cross cut on both surfaces. China.
 9. Crude hand-cut file from Indo-China.
 10. Thin flat file, $8\frac{3}{4}$ inches long, $1\frac{1}{4}$ inches wide. Cut only on the edges on both sides. China.
 11. File with a thin diamond shape cross section, finely cut on all four sides. Indo-China.
 12. Small file, cross cut on the two flat faces, but not on the edges. Japan.
 13. Dried tail of a fish, probably a Skate or Ray, used as a wood rasp. Yucatan.
 14. Knife-shaped file, cross cut on both sides and single cut on the back. China.
 15. Small file, blade thickest in the middle, finely cut on all four faces. Japan.
 16. Rasp, single cut only about half the length of the blade. Indo-China.
-

descriptions of primitive tool-making which still existed among the Indians of North America in the first half of the last century. Fol-

lowing is his description of the process of making files:

"The most curious process was making files and rasps. To do this, an alderberry stick was taken and split in two. The pith was then scraped out, and into the groove thus formed was poured glue mixed with pounded flint. When dry, the particles of flint formed the teeth of the rasp or file. If the file became dull, it was only necessary to wash it in hot water, which removed the top layer of glue and worn flint, bringing new flint to the surface. These files were very handy and of vast use to the Indians. What steel is to iron, they are to the wood and stone used by the Indians. When ponies' hoofs

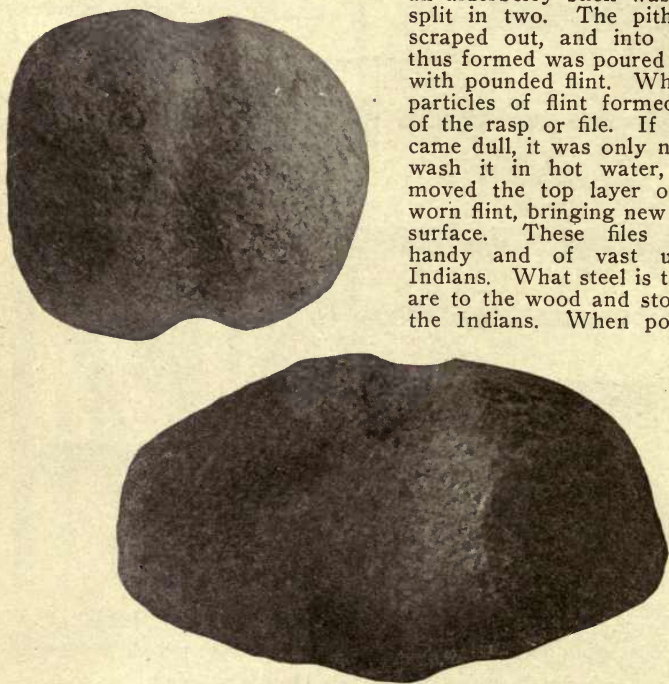


Fig. 13.—Typical heads of ancient stone hammers.

(Courtesy Am. Museum of Nat. History)

became too long, or splintered, they were trimmed down by these rasps. Axe handles, tepee poles, and iron even were rubbed down with them."

Another primitive form of file has also been brought from Aus-

China, Japan, and Yucatan are most interesting. Fig. 11 shows some of these files very clearly. In Fig. 12 is illustrated a number of old-time primitive files from China about which comparatively little is known,

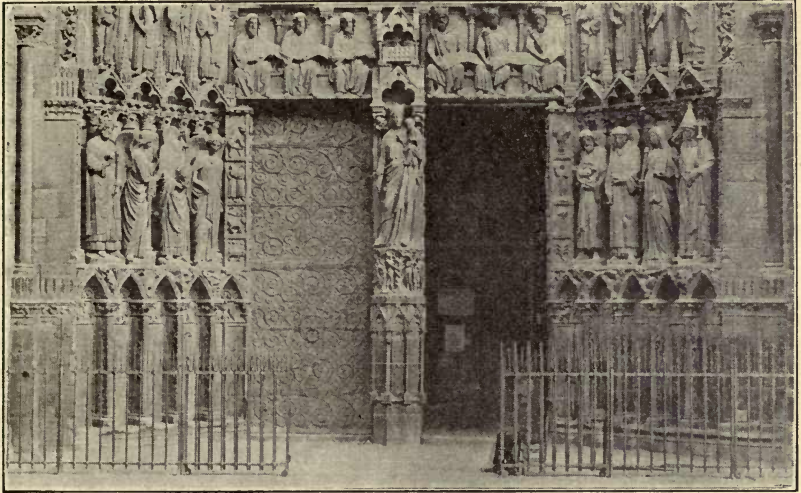


Fig. 14.—Entrance to the Notre Dame Cathedral showing iron work on doors.

tralia. It was made by fastening sharp fragments or plates of stone to a stick by means of a tenacious gum. It affords a good illustration of the manner in which flint and other flakes were mounted for use as files by the early inhabitants of Australia. This file is in the collection of the Peabody Academy of Science, Salem, Mass.

Interesting Collection Of Files In Philadelphia

A most remarkable collection of primitive files is preserved in the Philadelphia Commercial Museum. These come from all portions of the globe, but those from China, Indo-

but their different forms and cuts are interesting.

While this digression has brought us for the moment to comparatively modern times, it serves to illustrate the extraordinary variations in tools used at the same period, but in widely different places, and shows how difficult it is now to assign regular progressive stages to the development of implements and weapons in early times.

In this connection, the remarks of Mr. Wilfred H. Schoff, Secretary of The Commercial Museum, relating to the collection in that institution will be of especial interest:

"These specimens in our collec-

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tion are all of comparatively recent date, and their primitive character is due simply to the fact that they come from countries still in a primitive stage of civilization. For that reason, they illustrate, so far as they go, earlier conditions in nations now in a more advanced stage of civilization. In actual time, we do not suppose that any of the specimens shown would be more than thirty to thirty-five years old, and a number of them, of course, would be more recent.

"The progress of ethnological knowledge is, necessarily, dependent, in great degree, on modern instances just such as these, of tribes and races that have remained relatively undeveloped, while other races were becoming civilized, and in that way any specimen of a present-day primitive tribe is valuable as indicating what our own ancestors may have been ten centuries ago."

Until the beginning of the Christian Era even the blacksmith continued to fashion weapons and implements of iron almost entirely with a stone hammer, and no mention seems to be made during this

exceptionally efficient. So, while he used a variety of tools, he still clung to his hammer as the chief instrument of his trade. The blacksmith's hammer, in fact, remained his most important implement for many hundreds of years.

While slight mention is made of files in medieval times—when they must have seen their first great development—we know that much of the iron and steel work turned out could not have been accomplished without the aid of files.

During the Middle Ages, St. Dunstan, a monk born in Glastonbury, England, who is considered the patron of the blacksmith, produced many wonderful things, and greatly aided in the improvement of metal tools. While there is no record to that effect, the nature of his work would imply that the file received some benefit from his extraordinary genius. He died in 988.

Monk Wrote Book On File Making

Another monk, Theophilus Presbyter, of the Benedictine Cloister, Helmeshausen, gave to the world



Fig. 15.—Roman knife files found at Tilchester, Roman site, A. D. 43 to 300.

intermediate period of the use of files. The rapid appearance in slightly later times; however, of iron tools is shown by the discoveries at Pompeii, where the only tools of the present time which the blacksmith lacked were the vise and metal-cutting saw. His files were crude, and it is presumed were not

several recipes for tempering iron instruments. He also wrote a very interesting description of file-making in Germany about the end of the eleventh century. Among the simpler forms of files which he mentions are those made of soft iron, which were afterward hardened. After the file had been forged to

the desired form it was made smooth by a plane and then provided with grooves and teeth. He describes the hardening process very clearly, and, curiously enough,

wanted to discover how the work was done. Numerous theories were advanced, one of which affirms that the iron was cast, "and then treated with a file." This shows that the



Fig. 16.—Half-round files unearthed in London. Period unknown. They are all on the order of rasps.

it does not differ greatly from some present-day methods.

The men who worked in iron, and were the chief users of such tools as files, had become at this time the most important of the artisans. A guild of blacksmiths was formed in Florence in the thirteenth century, while in England the guilds of the blacksmiths were started in 1434. It is only natural to suppose that these men did much to develop the efficiency of the file in the course of their daily work.

The earliest point at which a definite thread in its history can be regained is when the Notre Dame Cathedral was built in Paris in the thirteenth century. A smith named Biscornette was employed to decorate the doors of the great cathedral with iron work. He performed this work, which was wonderful in its beautiful effects, secretly, by a process known only to himself. Bits of this iron were broken off at various times by people who

file at that time was becoming a necessary part of the smith's equipment. It proves, too, that it must have reached a very high state of perfection to have enabled a man to do such fine work in metal.

It was not until the fourteenth century, however, that those who practiced art in ironwork began to use other tools, besides heat and the hammer, regularly.

We read that "file and saw, vise and drill were called to his (the smith's) aid."

The use of these tools gave greater command over the metal as well as better results in the work. This, too, would tend to show a steady improvement in the file, rendering it more applicable to heavy work in metal.

Again, we find a reference to the fourteenth century grille in the Cloister of LePuy-en-Velay. Continuing his description of this, the writer says:

"The caps and bases are pro-

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duced by the hammer without the use of the file—processes soon afterwards abandoned.” This again would seem to indicate the growing importance at that time of the use of the file in metal work, the rough finish obtained from the hammer alone being replaced by the smoother effects acquired by filing down the rough parts and joints.

Germany Led In File Making

In the middle of the fifteenth century Nueremberg was the foremost place of production of files, but when the thirty-years’ war paralyzed the industry of Germany, Sheffield, England, became the centre of file manufacturing. Tradition says that from the earliest times the manufacture of files has been carried on in Sheffield. This is, no doubt, true, because we know that Sheffield held front rank in the manufacture of tools for hundreds of years. However, there is a record which states that the first file was made there in 1618.

When the Calvinists were driven from France, and the Netherlands, in 1685, a great number emigrated to Reimscheid, in the present Rheinisch-Prussia, and this district soon became the headquarters for the tool industry of the world. An auxiliary cause for this was the abundance of water power to be had in this district, and Reimscheid has ever since sent out files to all parts of the world.

Files at that time were classified according to their size, the way they were packed, their form, and also the purpose for which they were intended. The “coarse” files were heavier, as well as deeper cut, than the “finer.” With the “coarse” files were counted the “hand” files, “arm” files—sometimes as heavy as

20 pounds—and the “packing” files. They were also frequently called the “straw-files,” because they were shipped tied together with straw ropes. Fleischman, in Reimscheid, made a “coarse” file to order that had two hinges, and weighed forty-six pounds.

All these files were made for rough work and were bastard-cut, or so-called “Jack-files.” The finer files were generally named after the shape of their cross-cuts, and were also known as dozen files, because usually packed by the dozen.

The continued absence of examples of files of even this later period can be accounted for not only through the inevitable rust and consequent disintegration, but also from the fact that steel was still so valuable that when a file was worn out, it was probably used to make some other implement.

The Swiss began the manufacture of files at a very early date, but just when this was is difficult to say. They have always been noted for the excellence of their files, but they made a specialty of the very fine files used in the manufacture of jewelry, and, in later times, by watch-makers.

File Cutters Among The Colonists

In America, during the days of the early colonies, most of the files that might be required were imported from abroad, though a few artisans who had learned the trade in their mother countries may have produced some for local use. It is claimed that in 1698 there were in Philadelphia “artificers of many kinds, among them cutlers, gunsmiths, locksmiths, nailers, and file-cutters.” The records also show that a concern named Broadmeadow & Company was making files in a small way at their factory

in Pittsburgh, Pa., about 1829. With this exception, prior to 1840, the manufacture of files was practically unknown in the United States.

About 1845 the making of files on a small scale was begun at Matteawan, N. Y., by John Rothery, an Englishman. It is reported that he made excellent files, and his success induced others to enter into the business of making files. From

that time the manufacture of files took a firm foothold in this country, but until about 1864, Europe continued to supply the greater number of files used in America. It was a long uphill fight for the American file manufacturer, for most of the mechanics had come from abroad and were naturally prejudiced in favor of the files they had learned to use at home.



Fig. 17.—Half-round file discovered in Hood Hill, Dorset, Romano-British site. Period B. C. 50 to A. D. 50.

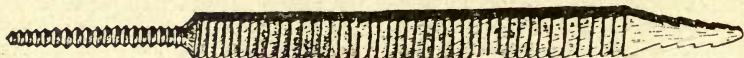


Fig. 18.—Combined flat and round file discovered at Hallstatt. Date about 600 B. C.



Fig. 19.—Cranked file found among the Roman remains at Silchester. Date 300 A. D. Teeth 5 to the inch, rather shallow, apparently filed in.

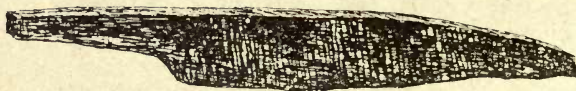


Fig. 20.—Rasp and knife-shaped files discovered by Prof. Flinders Petrie, at Thebes. Date about B. C. 670.

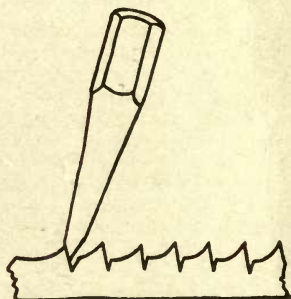
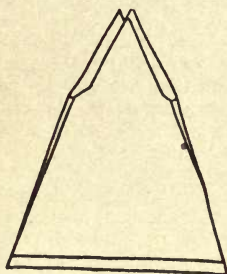


Fig. 21.—Chisel for large rough files. Chisel for small fine files. Showing angle of cuts.

PART II

MAKING THE MODERN FILE

THE manufacture of files, until comparatively recent times, was done entirely by hand. Just what methods the ancients pursued in making their files it is hard to say, but they must have followed similar methods to those in vogue up to about sixty years ago.

In cutting files by hand, the necessary tools are so simple, that, without doubt, those in use in the later days of the art, were similar to what the hand cutters of past generations must have used.

Roman files that have been found at Alis, Halstatt, and Come-Chandron, particularly those found at Halstatt, are of especial interest as they show one of the earlier methods of producing the teeth. That is, in some of the early files the teeth themselves were formed by filing. The files mentioned above gave every evidence of having been used for this purpose. The filing of the teeth, however, seems soon to have been replaced entirely by cutting. A chisel made of good steel made it possible to manufacture the file much quicker than by the filing method.

*Preparing The
File Blank*

In preparing the file blanks for cutting by hand the early stages were much the same as today. The blanks were forged to shape out of bars of steel that had previously been rolled. The forged blanks were then annealed to make them more susceptible to the cutting edge of the hard steel chisel.

After the annealing process the surfaces of the blanks were cleaned and leveled so that the entire sur-

face was accurate. This was done by grinding and filing. The usual practice being to file the small blanks and grind the large ones.

Then the blank was slightly oiled to allow the chisel to slip over it easily. It was then ready for the file cutter. This man was seated before a square iron anvil, usually solidly mounted on a heavy stone base. Provided with blocks of lead having appropriate grooves to fit files of various forms, he selected the one required and placed it on the anvil, adjusted the file blank in the groove, with the tang toward him. To hold the blank in place while being cut leather straps were used. These passed over each end of the file, and the ends were held down by the workman's foot.

The cutter would select a chisel suitable for the cuts to be made. See Fig. 13 A and B. Then with a hammer and this chisel he would cut the teeth in the blank by a rapid succession of blows, each time moving the chisel a slight, but regular distance, toward himself. The workman was aided in gauging this distance by the slight ridge or burr raised in advance of the tooth being cut, at each blow of the chisel. This is shown quite clearly in Fig. 13 C. For each new tooth the chisel was slid until it met this ridge, when it was ready for the next cut.

The chisel, held at an angle, cuts the groove and at the same time raises one edge of the metal, thus forming the tooth.

The hammer used in file cutting was of peculiar shape and weighed sometimes as much as six pounds. This caused great bodily exertion, which, in conjunction with the constrained position of the file cutter over the anvil, was very injurious

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to health. All this has been done away with by the use of machines which will be described later.

Where double cut files were being made the first cuts (so-called "over-cut") had to be oiled over to allow



Fig. 22.—These are typical hammers used by hand-file cutters. The grooves in the handle of the smaller hammer have been worn in by the grasp of the hand through many years' use.

The peculiar shape gives better direction to the blow and puts the weight at the lower end of the hammer-head, providing greater ease in working.

the chisel to slip over the surface, which would otherwise have been too rough. First cuts were smoothed over with a file so the chisel would work freely.

During this operation of hand cutting the file became slightly bent. To eliminate the danger of breakage, the file was treated to a red heat before being straightened. It was then ready for the hardening, which was, of course, performed according to the individual ideas of the maker. The method, however, was substantially the same as used today with the exception that open fires were used.

The tangs were softened a little

after this operation to prevent breakage.

Hand-made files were produced with an astonishing degree of dexterity which was only to be acquired by long practice. The burrs cut on a file with a sharp-edged chisel were produced at the rate of 150 to 200 per minute. While traced by the sense of touch alone, the lines were nearly as straight as though cut by a machine. Such skill was long thought to be proof against the aggression of machinery. As a matter of fact, the wholesale introduction of machinery into file making would probably have been deferred until a great deal later date than it was had it not been for the chronic discontent of the file makers themselves. In those days strikes for higher wages were very frequent and the manufacturer was eventually compelled to choose between labor-saving machinery or loss of trade. This brings us to the history of file-cutting machines.

Cutting Files By Machine

As stated, the file cutters themselves were mainly responsible for the final adoption of machinery in the manufacture of files.

While it was not until around 1860 that this change began to take place, the efforts of inventors had been directed toward the perfection of a suitable machine for several centuries. It is a well-known fact that the ancients showed remarkable mechanical genius and produced the basic ideas for many modern tools and machines. Yet there is nothing in history to show that they ever dreamed of cutting the file in any other way than by hand. The first authentic record of a machine for the cutting of files

has been obtained from a manuscript left by the great Italian painter, Leonardo da Vinci, who was also famous as an engineer. In 1502 he was appointed chief en-

make the machine independent of crank and "manpower." A weight and rope set the main shaft in motion. The length of rope and height of weight (giving length of

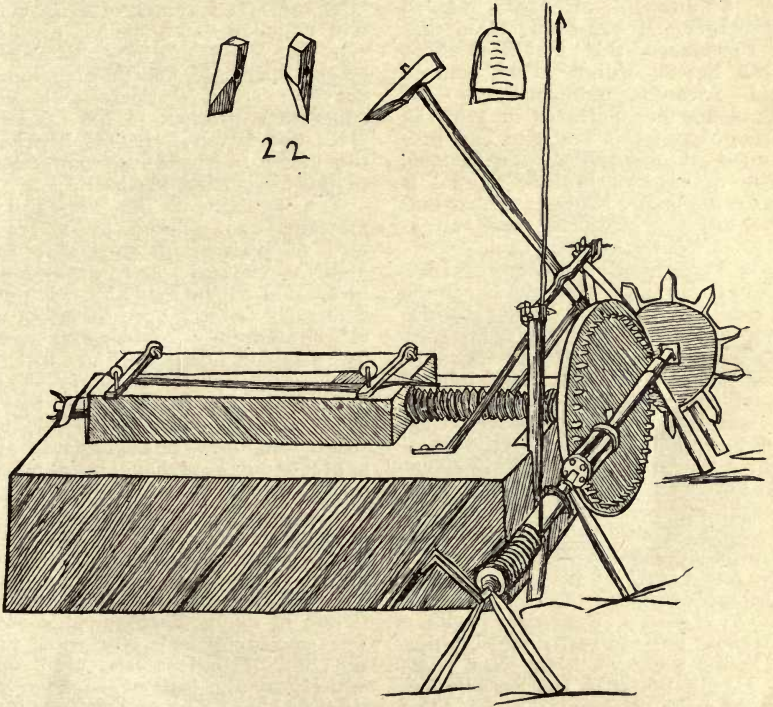


Fig. 23.—Copy of sketch by Leonardo da Vinci, illustrating his invention of a file-cutting machine, 1505 A. D.

gineer and architect of the Duke Caesar's army, and it was during this service that he conceived the idea of a file-cutting machine. Fig. 14 shows a reproduction from his drawing of this machine which he invented some time before 1505. An examination of this drawing shows that all parts of the machine have been carefully carried out and it is complete in all details. According to his description, he intended to

ultimate downward travel) to be according to the length of file to be cut.

This device shows his wonderful inventive capacity and mechanical skill, since even sixty years ago we had not advanced much farther than the design here shown.

Mathurin Jousse in a work entitled, "La Fidelle Ouverture de l'Art de Serrurier," published at La Flesche in Aujon, 1627, gives a

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drawing and description of one in which the file is drawn along by shifts by means of wheel work, the blow being given by a hammer.

Another machine was invented by a French mechanic named Duverger. It has been stated that he produced this machine about 1735, but according to the *Journal des Savants*, published by the Academie des Sciences in 1702, he brought out this machine and presented it to the Academie in 1699. The description in this journal is very complete, and it seems that the machine attracted wide attention at the time.

In 1725, another file-cutting machine was invented by Fardonet. Thiout in his "*Traite de l'Horologie*," published at Paris in 1740, describes still another machine. Brachal and Gamain also produced machines in 1756 and 1778.

James Watt, the famous Scottish engineer and inventor of the modern condensing steam engine, endeavored to make a file-cutting machine. He was not successful because he did not have a "pressure foot." This is a device which holds the file firmly in place during the cutting operation, and it was not until it was perfected that a machine became really serviceable.

While these machines were crude and only partially successful, they showed the way for other inventive minds. One of these later inventors who met with more practical success was another French mechanic named Raoul. In 1800, he produced a machine which made excellent files. He obtained a report on them from a committee of the Lycee des Arts in which it was stated that they were equal to the best English hand-made files. His machine, however, was only used to make watchmakers' files.

At first sight, it would appear from the simplicity and continual

repetition of the movements required in file-cutting that it was an operation especially adapted to be performed by machinery. Nevertheless, it was not until many years after the first inventor of a file-cutting machine had patented his device that file-cutting machines were successfully used, and that machine-cut files could compete with the hand-made product in the market. Over two centuries passed between the suggestion and the perfection of the file-cutting machine.

The advent of the file-cutting machine was marked by a great deal of opposition, for most file makers claimed that high-grade files could not be made by machine. The early failures bore them out in this contention, for when first made by machine, the machine had a tendency to curl the tooth. This prevented the tooth from being sharp, and the file failed to do its work, but today, one wonders how a file could ever have been properly made by hand.

Machine Cut Files Are Best

It has been said that the early failure of many machine-made files was caused by lack of care in the selection of the material used, not entirely by the lack of efficiency in the machines, for with a machine-made file the teeth are of equal height and every tooth cuts. In the hand-made file the teeth vary—sometimes to a considerable extent. A machine-cut file will really do more work and last longer than a hand-cut. It took time to prove this, however.

The Swiss, always famous for the quality of their files, especially the small sizes for dentists, watchmakers, etc., are said to have been among the first to use machinery.

While hand-file makers claimed

that the peculiar angles at which the chisel must be held precluded the same results with machines, investigators discovered that the results obtained from the action of the chisel were only according to natural laws which machines could easily produce.

The failures of the early file-cutting machinery, however, discouraged mechanics, and led them to believe that nothing could ever equal the hand-cut file.

The first effort to build a suitable file-cutting machine in the United States, so far as can be ascertained, was made by Morris B. Belknapp, of Greenfield, Mass. On January 16, 1812, he patented a file-cutting machine which did not prove commercially successful. A certain William T. James also patented a file-cutting machine in the same year.

In 1836, Captain John Ericsson, then in England, patented a file-cutting machine which is described in Holzapffel's work on "Mechanical Manipulation," where it is stated that one machine could do the work of ten men. This was followed in 1847 by an ingenious machine invented by George Winslow, of Boston.

First Machines Greatly Imitated

As in the case of many other inventions, as soon as the first machine appeared there came a rush of imitators. There was, as a consequence, quite a lengthy list of patents taken out on file-cutting machines around this time. It would be useless to name them all. Therefore, only those possessing the most meritorious points, or which laid the foundation for future improvements, have been mentioned.

The first really practicable ma-

chine was that invented by E. Bernot, of Paris. This machine, which is shown in Fig. 15, was used to some extent with success in France and Belgium, and about 1860 was introduced into Great Britain. It was patented in the United States July 24, 1860, and later was brought into the country.

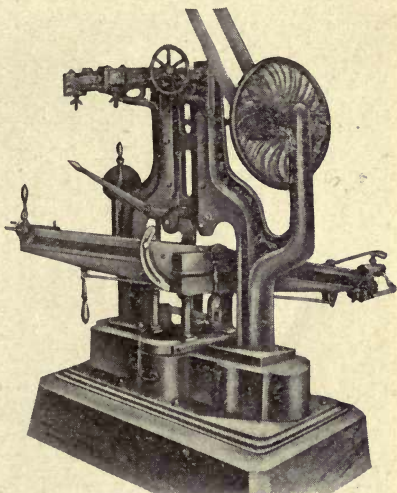


Fig. 24.—Machine invented by E. Bernot—the first practical file-cutting machine.

In 1862, M. D. Whipple, of Cambridge, Mass., made a number of improvements for file-cutting machines, but the biggest step forward was when, in the same year, some enterprising capitalists in Baltimore secured the right to make and use Bernot's file-cutting machine in this country. Nine of these machines were built with slight modifications and set up in Pawtucket, R. I., where they ran with great success.

On January 16 and June 13 in 1864, patents were again issued to Morris B. Belknapp, of Greenfield, Mass., for a new machine for cutting files and sickles. This machine cut from five to six dozen twelve-

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inch files daily. On April 11, of this year, patents were also issued to Charles Hesser and Amos Paxson, of Philadelphia, as well as to William T. James, of Greenwich, N. Y., for file-cutting.

In 1865, W. T. Nicholson, of Providence, R. I., invented a file-cutting machine, which, "as im-

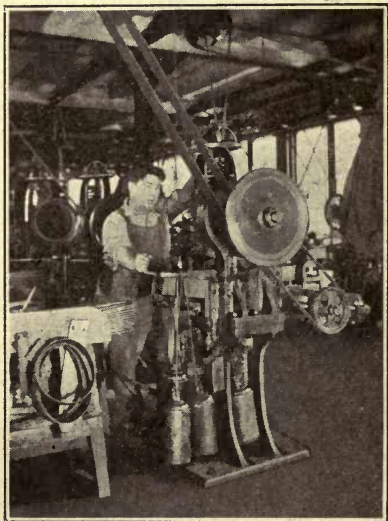


Fig. 25.—A Disston File-Cutting Machine
—the finest type of modern machine.

proved and modified from time to time, is still extensively used in the United States.

Disston's Begin The Manufacture Of Files

In the sharpening of saws, a great many files are used. During the War of the Rebellion, Henry Disston & Son (this being the firm name at the time), unable to obtain files which would give satisfaction, found it necessary to make files for their own use. This becoming known, it was not long before requests were received from custom-

ers that they be supplied. The demand increasing, it was decided to enter the field of file-making, and in 1866 a plant was equipped and additional skilled workmen employed to turn out high-grade files. As with his saws, Henry Disston always wanted to turn out the best, so he gave his attention to the production of a file that would be superior in quality, shape, and cutting power of teeth. Although his first files were made by hand, he realized early the necessity of machines in the production of perfect files.

As none of the machines so far invented were considered exactly perfect, the Disston Works carried on extensive experiments for the production of file-cutting machinery that would be adequate to meet every demand. Their efforts were successful. In 1877, the Disston Works started to make files by the aid of their own machines. Constant improvements were made from year to year until today the teeth of Disston files are cut upon the most perfect file-cutting machines.

In 1866, the Sheffield Telegraph, of Sheffield, England, held a contest to reach a final decision as to whether machine or hand-cut files were best. One side of each file used was machine-cut, and the other hand-cut. After exhaustive tests the firms trying out these files without a knowledge of which side was which, decided in favor of the machine-cut files, which forever settled a controversy that had been waged for two centuries.

As has been shown in the foregoing history of the file, many of the present forms of the file were substantially originated in the earliest days of its history. These have been modified and added to as the knowledge of file manufacture increased, and new and different

uses were discovered. There are today a large variety of files being made. These various forms will be taken up in the later parts of this article, but we will first consider the making of the modern file. In describing its manufacture the word

methods therefore, will give a clear idea of the manufacture of the modern file.

There are, of course, quite a number of points upon which the high-grade file depends for its superiority. The principal ones are:

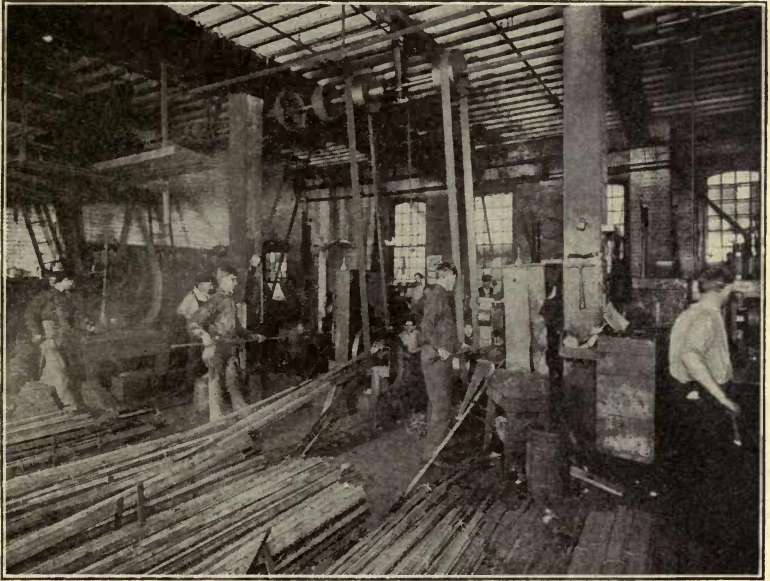


Fig. 26.—Steel room, cutting to multiples or sections.

file is used in its broad sense as applied to both files and rasps, irrespective of either size or form.

Disston Company Make Greatest Variety Of Files

Although not the oldest manufacturers of files in this country, the Disston File Works today is well equipped, and turns out the greatest variety of files made. A general description of the Disston

Tough steel of a high grade suitable for the purpose.

Proper forging and annealing.

Sharp and well-formed teeth.

Thorough hardening.

Careful inspection at every stage of the work.

The real basis of the file is the steel. All manufacturers endeavor to obtain the very finest steel possible for the purpose, but the quality of the steel is bound to vary to some extent unless the manufac-

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turer has some way of controlling the output. Steel for making files requires a high percentage of carbon to obtain the requisite hardness. This carbon-content is apt to vary unless the "mix" is carefully regulated.

where the chemical and physical tests of the steel are made. Constant experiments with proper ingredients to maintain and enhance its quality, are conducted in connection with the steel works.

After the special steel has been

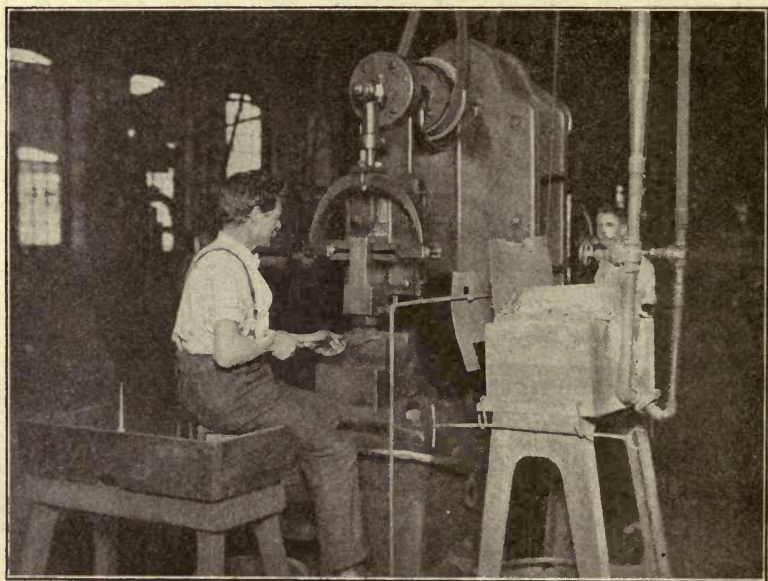


Fig. 27.—Forging.

Make Their Own Steel

Henry Disston & Sons began to make crucible steel as early as 1855 so that when they took up the manufacture of files they were in a position to obtain steel of a high and uniform quality. The Disston Steel Works, which includes the melting department, rolling mills, steam hammer shop, and trimming room, occupies several commodious buildings. There are laboratories

carefully and properly melted, it is poured into moulds. When the steel is cool, the mould is removed and the ingot which has been formed is then turned over to the rolling mill, where it is reheated and rolled into large bars. These bars are then cut into smaller pieces, and the pieces are again heated and run through different size rolls, which reduce the diameter, but increase the length. The last roll through which the steel passes reduces it to the particular

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size and imparts the shape or form desired, such as round, half-round, flat, three-square, etc., each thickness and shape being specially rolled.

It may be of general interest to learn that in rolling steel for a 14-inch flat file, which is approximately

size and shape required for the file and is then approximately 50 feet in length. This long bar or rod of steel is cut in ten or twelve-foot lengths and sent to the file works, where it is cut into multiples the length of the file to be made.

The first step, then, in the actual

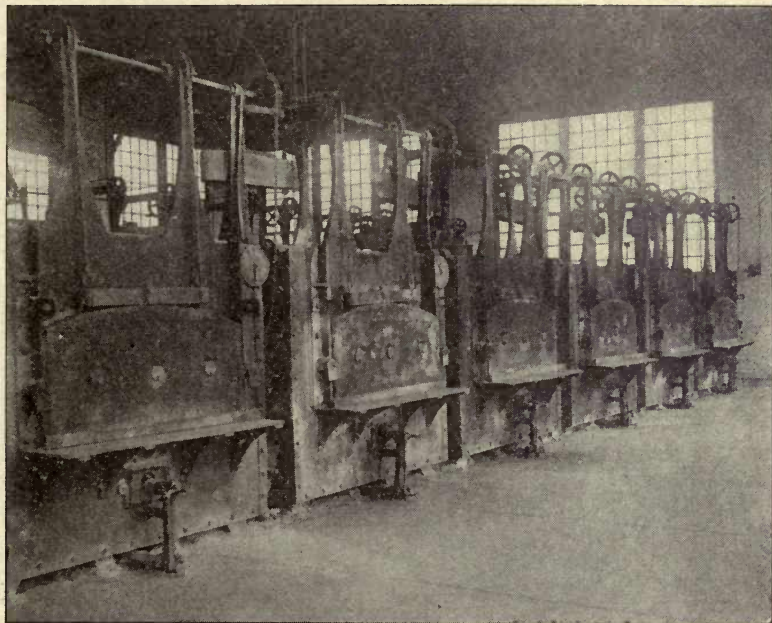


Fig. 28.—The annealing ovens where the blanks are softened before cutting the teeth. There are eighteen of these ovens in this same room.

1 7-16-inch wide by $\frac{3}{8}$ -inch thick, the bar, as referred to above, meas-

manufacture of the file is the cutting of these long rods of steel into



Fig. 29.—Tang of a file.

ures 4 inches by 4 inches, 24 inches long. This is heated and rolled through one roll after another continuously, until it is reduced to the

pieces or sections of the required length. The pieces of steel thus formed are termed file blanks.

The file blank is then "tanged."

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The tang is the smooth, pointed end on a file which may be fitted to a handle when in use, although very frequently the file is employed without the handle. The tang, while forming part of the file, is never included when measuring the length of a file.

a certain degree of heat. Forging the tang requires a certain amount of skill, but so expert are the men who do the work and so quick their actions, keeping time with the rise and fall of the power-driven hammer, that the tang is formed in less time than it takes to describe it.

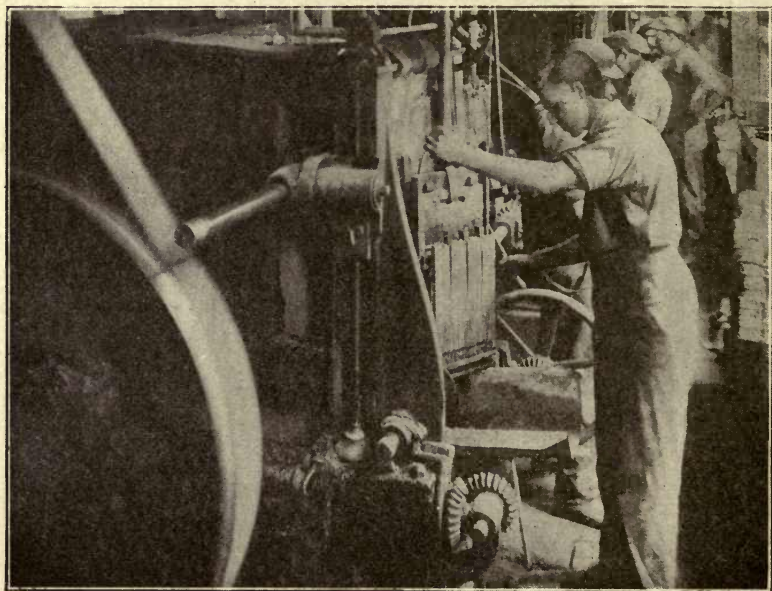


Fig. 30.—Grinding file blanks.

Forging The Tang

For the tanging operation the blanks are taken to the forging room where one end is heated and forged or shaped into the tang. The operator is seated before an automatic hammer with a small furnace close at hand, in which the blanks are inserted and one end heated, the temperature of the furnace being uniformly maintained at

In the case of some of the shapes of files, after the tang is formed, the other end of the blank is heated and forged to shape or rounded.

Before the blanks can be ground and the teeth cut it is necessary to soften the metal. This is called annealing, and is the next step in their manufacture. To do this the blanks are put in air-tight metal boxes, placed in an oven, and subjected to a predetermined degree of heat for a number of hours. When

taken out of this oven they must remain in these boxes until cold. Otherwise the whole annealing process would be useless, for the files would become hard again if allowed to cool in the open air.

These various heating and reheating operations through which

are "stripped." This operation takes away the glaze left after grinding and prepares the surface for cutting. By a special process the file blank is rubbed down, or filed by a finished file especially made for the purpose. This work is done on a machine, but it is



Fig. 31.—"Stripping" and "Cutting" small files.

the file blank has passed cause it to warp, or twist, and it is necessary next to take them to the straightening department, where they are made level for the grinding operation which follows. This grinding operation is quite an important factor in the making of a file, for the blank must be ground to remove the scale and oxidizing and made perfectly even, or else when toothed the teeth will not be uniform.

After being ground, the blanks

necessary for the operator in attendance to rub on, constantly, a preparation which renders the surface of the blank even, flat, smooth and firm.

Cutting The Teeth

After the stripping process the blanks go to the cutting room where the teeth are cut in them. This operation was formerly done slowly and laboriously by hand, as

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we have previously described. It is now done entirely by machine in the Disston Works, except for a few classes of odd shapes of files which must be cut by hand. Modern practice has demonstrated, however, that the hand-cut file cannot possibly possess the same high effi-

one side and the second cut, or "upcut," is put on, the teeth running in an opposite direction. On some machines the chisel is turned instead of the bed. On page 26, Fig. 16, is illustrated one of the machines on which Disston files are cut. This style of machine

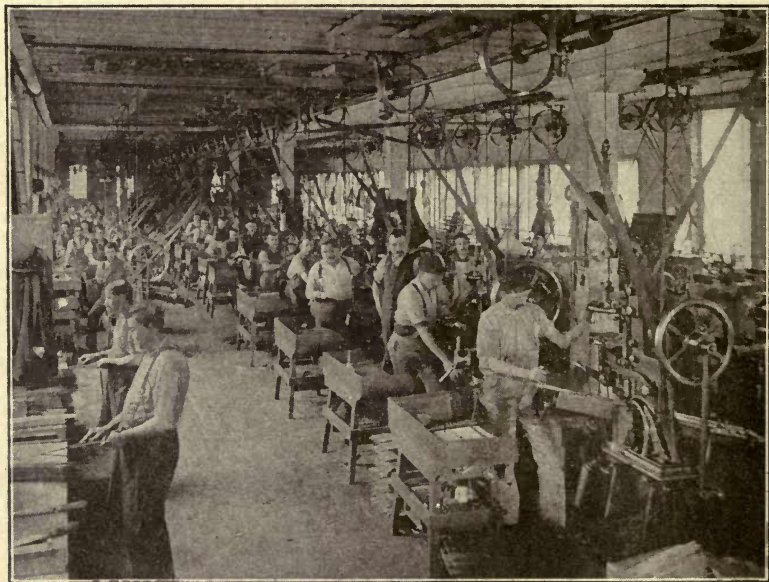


Fig. 32.—"Cutting" large files.

ciency that a machine-cut file does for the reason that the machine will do the work uniformly from the beginning of the day to its close. During the cutting operation the blank is secured in a "bed" which travels back and forth under a chisel that "raises" the teeth at a speed the eye can hardly follow. When double-cut files are being made the blank is put through the machine and "overcut." Then the position of the bed is shifted to

represents the highest development in file-cutting machines, and is one of the many reasons why Disston files are so superior, both in the efficiency and endurance of the teeth. Aside from the machines being differently constructed, the main difference between cutting files and rasps lies in the chisel used. For files the chisel cuts an angle all the way across the file at one stroke, while the bed moves steadily. In cutting rasps, however,

a pointed punch of peculiar form is used. This punch travels back and forth across the blank, the bed moving only after each row of teeth is completed.

In cutting half-round files the chisel cuts the teeth in rows, lengthwise of the file blank instead of

After passing inspection the file is "cropped" or cut to exact length. This operation consists of cutting a small portion off the point of the file to bring it to proper length. When "cropped" the file is stamped with the famous Disston brand on the end just above the tang.



Fig. 32.—Where files are hardened.

straight across, the bed being moved back and the position of the blank changed as each row is finished.

Disston Files Rigidly Inspected

When the teeth have been cut the files pass into the inspecting room where a thorough examination is made of the teeth. If these are not absolutely perfect the file is rejected.

With the very small sizes of files it is necessary to straighten them after the teeth are cut. This is done by placing the file on a lignum vitae block and striking it a light blow with a lead hammer, which will straighten the file without affecting the teeth.

The file is then covered with a paste that protects the edges of the teeth during the heating for the hardening process, which is one of the most important operations. The coated file is heated by being im-

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mersed in molten lead, withdrawn and plunged deep in a bath, moved back and forth a few times until somewhat cooled. While the file is still hot it is given a final straightening.

from the file the paste that was put on to protect the teeth during the hardening. In the second, the files are washed in lime water and are dried by holding them in steam.

The next and last operation in



Fig. 34.—Section of superfine file department.

Putting On The Finishing Touches

From a comparatively soft state the file has now become so hard that an attempt to bend it will cause it to break. Files are never tempered, but hardened to a particular degree which gives greatest durability. After this comes the "scrubbing" and "drying." The first of these operations removes

the making of a file before the final inspection, is "blueing" the tangs, and oiling the file. This "blueing" operation toughens the tang against breakage when putting on the handle. It is done by heating and dipping the tang into a preparation that is maintained at a certain degree of heat.

The files are then oiled, neatly arranged in wooden trays, and sent to the inspectors for final examina-

tion and test for straightness, cutting qualities, and durability.

Successfully passing the examination, they are proved as to cutting quality by the inspector drawing the "prover"—a piece of steel 90 degrees hard according to the Brinell tests—over each side of the file; if the file "takes hold" of this it is next given the "ring" test, the inspector dropping one end of the file on a block of steel and determining by the ring if it is sound and true. The files are now ready for the final step—packing.

Making Extra Fine Files

In the manufacture of superfine files, of which Henry Disston & Sons make a specialty, the majority of the operations are similar to the methods we have been describing. Steel of the same quality is used. It is cut into multiples in the usual manner, followed by the "tanging," "annealing," "straightening," and "grinding" operations with which the reader is now familiar.

The method of manufacture differs slightly after the grinding operation. The superfine file blank is put through a "shaping" process which corresponds in effect to the "stripping" operation in the case of the larger files.

To do this the file blank is secured in a vise, and the soft surface (the blank not having been hardened as yet) is smoothed down with a finished file made especially for the purpose.

As in the "stripping" operation described for regular files, this process is necessary to make the surface of the blank smooth and even before the cutting operation, which follows.

Owing to the fineness of teeth and the different shapes in which the superfine files are made, the "toothing" operations are also somewhat different.

On files that are made for extra fine work, such as those for jewelers', dentists', and surgeons' use, the teeth are "etched" in. This method of toothing a superfine file is done with an apparatus of very peculiar construction. It differs radically from the methods used in cutting larger files, involving a greater amount of hand work, but this is necessary on account of the fineness of the teeth.

In cutting the teeth of a half-round superfine file it is necessary to use two "beds." The file blank when fitted in the "groove" of the first "bed" is nearly on edge with the flat side toward the operator. The teeth are then "raised" or cut in narrow rows at an angle to the line of the file blank, but only half way around. Another "bed" is then substituted. This also stands the file blank nearly on edge, but with the round side toward the operator. The teeth are cut toward the center until they meet the last row of teeth cut from the other side. To shift the "bed" so that the chisel can cut each row, a worm-gear, adjusted by the operator is used.

In the case of a single-cut file the cutting of the teeth would now be finished, but in cutting double-cut files the operation is gone over again. This time the center of the chisel is over the spot where two rows of teeth connect. In this way the chisel "upcuts" over half of each row—the "upcut" teeth running in an opposite direction to the first teeth.

After the toothing operation, the superfine files go through another straightening process before the hardening. This straightening is also done with a lead hammer so

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that the teeth will not be damaged in any way.

They are then taken to the hardening room and hardened, which operation, together with the "straightening," "scrubbing," "drying," and tang "blueing" that fol-

low, is done in the same manner as with larger files.

The files are then sent to the inspecting room where, before being packed, they are given the final inspection and tests similar to those described for regular files.

PART III

FORMS AND USES OF FILES

THE foregoing closed the history of the file as well as the details of its making. To make this article more complete, however, it will be extended to embrace a general description of

or form of teeth. Many files of different shapes have teeth of similar form, as there are only a certain number of standard forms of "cut." For this reason the variations in the "cut" or form of teeth

SINGLE CUT

Particularly adapted for saw filing, also used on lathe work by machinists and by some classes of wood workers, carriage builders, etc.



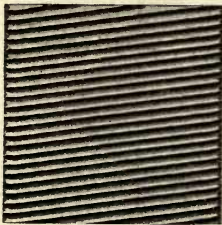
Rough



Middle



Bet. bastard & middle



Bastard



Second-cut.



Smooth

Fig. 35.—These "cuts" are in general use for 12-inch files. On files longer than 12 inches the "cut" is made proportionately coarser and finer on shorter lengths.

the forms and uses of the modern file; for so widespread is the use of this tool—so interwoven with the industries of the world—that it has become indispensable.

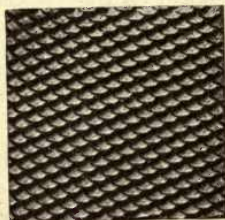
Files, according to the purposes for which they are intended, differ in shape and thickness, and in "cut"

will be considered first. With a thorough understanding of this, later references will be much clearer.

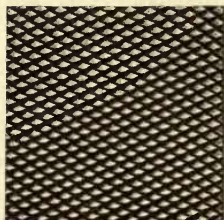
In the first place, the term "cut" refers to two characteristics of the teeth and is a general term that must be supplemented with a more

DOUBLE CUT

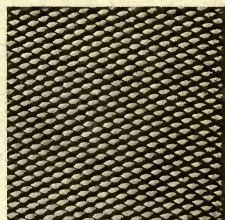
Fig. 36.—Especially adapted for use in machine shops, locomotive works, foundries and similar classes of work.



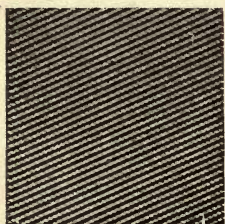
Rough



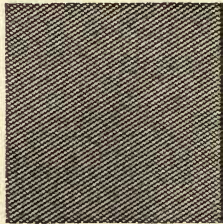
Middle



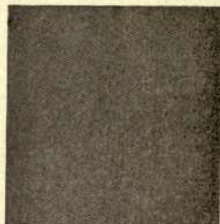
Bastard



Second-cut

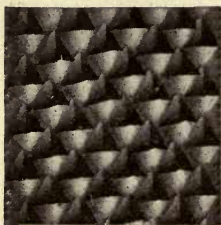


Smooth
RASP CUT

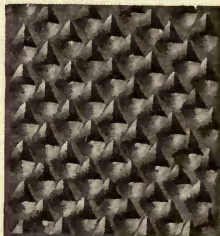


Dead smooth

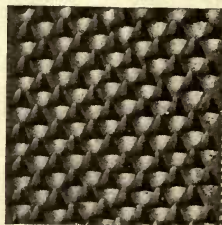
Fig. 37.—Used by blacksmiths, horseshoers, plumbers, cabinet makers, wood workers, etc.



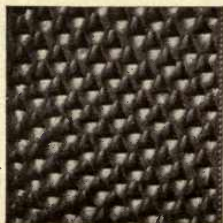
Horse



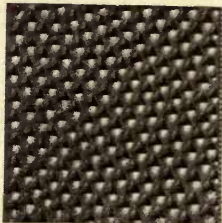
Rough



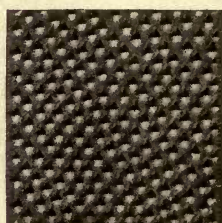
Middle



Bastard



Second-cut
[38]



Smooth

definite designation when an exact description of the file is intended. The kind or character of the teeth in a file, as well as the degree of coarseness or fineness, are both embraced in the general term "cut," but each of these characteristics has its separate classification. The character of the teeth is described under three main divisions, viz.: single cut, double cut, and rasp cut.

The single cut file has one unbroken course of teeth or chisel cuts across its surface, parallel to each other, but usually at an oblique angle to the length of the file. Chisel-like, it makes a smooth cut. A few patterns of files, however, have the teeth cut square across the face of the file and more widely spaced. This is called the float cut and is used for filing lead, babbitt, or other soft metals, and also for cork and wood. The wide space between the teeth is necessary that the file may free itself of the cuttings, which in a finer cut file would fill up and clog the teeth.

The single cut is used on the majority of mill files, taper saw and other saw files.

The double cut file has two courses of chisel cuts crossing each other, both oblique across the file blank. The first course is called the "over-cut" and the second course the "up-cut." Its direction being across the first course, the chisel cuts through the over-cut. Consequently the teeth of double cut files are "points," and those of single cut files are chisels. The double cut is used on all machinists' files, such as flat, hand, square, round, half-round, etc., with the exceptions of the round bastard files 10 inches and under in length, and second cut and smooth files 16 inches and under in length which may be single cut.

Rasp cut differs from both the

above in that the teeth are not placed in parallel rows across the file, but are staggered, each tooth being put in separately by a pointed tool or punch. While cutting uniformly, rasp teeth, because they are larger and raised higher, cut much faster than either single or double cut teeth.

The illustrations of "cuts" on the preceding pages are engraved from files and rasps 12 inches long; if longer than 12 inches the cuts will be coarser, and if shorter, they will be finer in proportion.

Varying Degrees Of Coarseness

The degree of coarseness is denoted by the names bastard, second-cut, and smooth. In addition to these there are coarser cuts known as rough and coarse; also a finer cut identified as dead smooth.

The name bastard as applied to the cut of a file comes from the days when files were entirely cut by hand and it is supposed to have been given to a cut between what was termed rough cut and the finer grades of cutting, and the file became a standard, taking the place of rough or coarse cuts and has been known since then as the bastard cut. The same is the case in the names of flat bastard and hand bastard files; while both are the same as to cut, they vary a little in shape and both are often used for the same purpose.

The various groups or classes of files have certain accepted standards for the cuts to be used. Reference to the explanation above of the single and double cuts as well as to the illustrations will afford a fairly complete index to these. It is well to bear in mind that a "rough-cut" or coarse file has the least number of teeth to the inch,

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while the "smooth-cut" or fine file has the greatest.

Exceptions to the standard forms and cuts of files are sometimes found in the various trades. To meet certain conditions peculiar to a business special forms and cuts are sometimes necessary.

PRINCIPAL FORMS OF FILES



Round



Square



Three-square



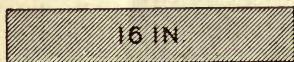
Pit saw



Half-round



Cant or lightning



Mill



Flat



Pillar



Great American



Horse rasp



Shoe rasp

Fig. 38.—The above are actual-size sections of different types of files of the length given on each section. The illustrations of files following, however, are considerably reduced in size, but show comparative shape.

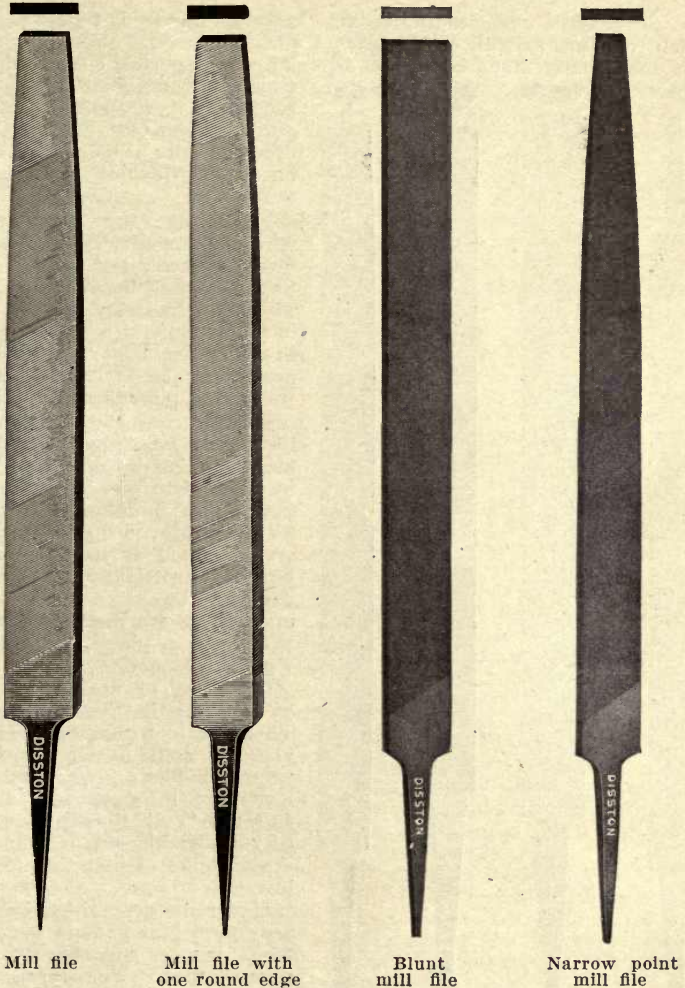
In this connection it is well to state that while there are accepted standards for the character of the teeth, there is no established rule fixing any certain number of teeth to the inch for any particular cut. Consequently there is more or less of a variation in the number of teeth cut to the inch by different manufacturers. Owing to the very large quantity of files used in the shops of Henry Disston & Sons—over 35,000 dozen annually in their

saw works and handle department and machine shops—they are in an exceptionally favorable position to judge the results obtained from all classes of teeth. The standards which they have adopted, therefore, may be taken as the final word regarding the shape and number of

teeth to the inch necessary to obtain the highest efficiency from a file.

Varieties Of Files

Having explained as clearly as possible in the foregoing, the differences in the teeth of files, we will now take up the varieties of files, together with some of their uses.



Mill file

Mill file with
one round edge

Blunt
mill file

Narrow point
mill file

Fig. 39.

Modern files, though employed chiefly in the forming and finishing of metals and wood, are also used to a considerable extent upon other substances, such as bone, leather, celluloid, hard rubber, etc. The general use of files is in shaping

small pieces, or in finishing surfaces which are already of approximately correct form. In machine shop practice the use of the file follows the work of the lathe or planer tools.

Files are graded by shape, size,

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and fineness of cut, and the forms given to them, as well as the sizes, run into many hundreds. Of all

several hundred types of regular files and several thousands of regular and special combined, all of which are designated by a name according to the length, shape, and grade of the cut; besides the hundreds of special names for the purposes for which they are made and used.

The sizes range from the fine, wire-like jewelers' file to the large, heavy machinists' file—from the tiny superfine broach file, 3 inches long, and less than 1-32 of an inch in diameter, which weighs only .008 of an ounce, 1800 to the pound, to great circular facing files which weigh 135 pounds each.

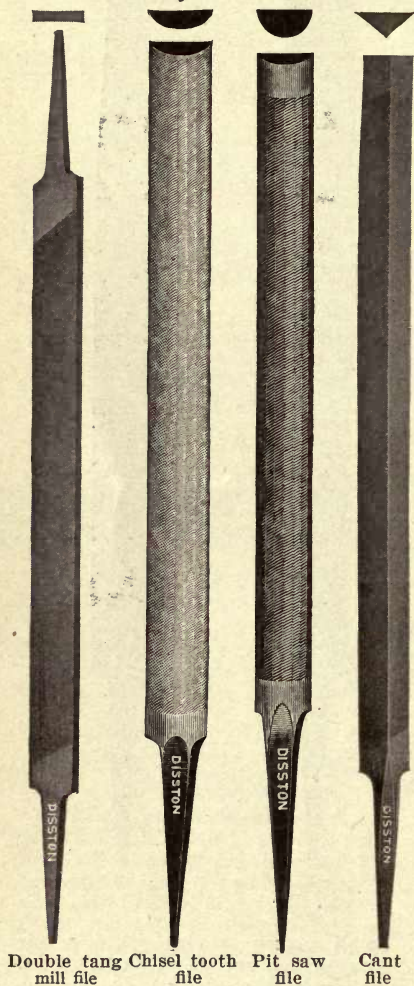
In the character of their teeth they vary even more greatly, from the deep, coarse rasp-cut files used by farriers to the dead-smooth surfaces of the delicate little implements employed by jewelers. Files are classified as to coarseness and fineness principally by the "cuts" described on pages 37 and 38, and upon these are based the variations which are required by the class of work to be performed.

On page 40 are shown sections of some of the files in general use. These basic forms, with slight deviations, control the forms of the principal files now manufactured. Reference to these sectional views and the "cut" illustrations will be of considerable aid in following the descriptions of files that are to follow.

Under the general heading of files are found four groups, viz.: regular files, rasps, superfine files, and special files. These four groups in turn resolve themselves into other divisions which embrace a great variety of files.

In picturing and describing these different files, the group of regular files will be taken up first.

There are two divisions of regu-



Double tang mill file Chisel tooth file Pit saw file Cant file

Fig. 40.

tools known there are none used for so many purposes and of so many styles as files. There are

lar files—saw files and machinists' files.

As the name implies, saw files are particularly adapted for sharpening saws and also for work similar to filing the edge of plates or sheets, for which the double-cut files are not suited. They are single-cut and in degree are usually bastard-cut, second-cut, and smooth-cut.

The class of work performed in machine shops necessitates a different character of "cut" from the above—hence machinists' files are usually double-cut and in degree rough-cut, bastard-cut, second-cut and smooth-cut.

The repetition above of the word "usually" may appear peculiar, but it is used advisedly, for it may truly be said that in no other line of manufacture are there so many variations from regular as in the file business.

Of the class of saw files the one having the widest range of shapes, sizes, and cuts, is the mill file.

Mill files derive their name from the fact that they are used principally for filing mill saws and for sharpening planer knives. They are also used, however, for sharpening mowing and reaping machine knives, as well as for certain kinds of work by mechanics, such as lathe work, draw-filing, etc. They are used, too, for finishing combinations of bronze and brass. Having chisel teeth they leave a comparatively smooth surface, which double-cut teeth do not, though double-cut teeth cut faster. All mill files are single-cut.

Mill files are forged tapering from near center to point. This applies to both width and thickness, as they are slightly thinner and narrower at the point.

Mill files are also made with one and two round edges, single-cut

both on the sides and edges. The round edges make the mill file more adaptable for filing the teeth in circular and other mill saws. The use of the round edge prevents the formation of sharp corners or notches in the gullets between the saw teeth.

Blunt mill files are parallel in both width and thickness. This gives the full width of the surface for the entire length of the file. Otherwise they are the same as those just described. These are rarely used by millmen, but are mostly in demand for machine shop work.

The narrow point mill file is another variation of the mill file. There is no particular advantage in the extra narrow point, it being simply a matter of preference. Very few narrow point mill files are sold in the United States. The majority of those manufactured go to Canada.

There is also a special mill file having what is called a fine bastard cut. This is a cut between the bastard and the second-cut, and is used by many who prefer a file that will meet certain requirements in saw filing which a bastard or second-cut file will not.

The double tang mill file is meant for use with two handles. A man can then grasp it conveniently with both hands. It is used chiefly for draw filing.

A saw file which departs somewhat from the standard form is the chisel point file. This is made especially for use in sharpening the points of inserted tooth circular saws.

The pit saw file is used for filing the teeth in pit saws and frame saws. When used for the latter purpose it is sometimes asked for under the name of frame saw file.

The cant or lightning file is frequently used for sharpening the

teeth of wood saws, or, as more commonly known, buck saws. Its principal use, however, is to sharpen the teeth of cross-cut saws having M-shaped teeth, and to sharpen the raker teeth of cross-cut saws.

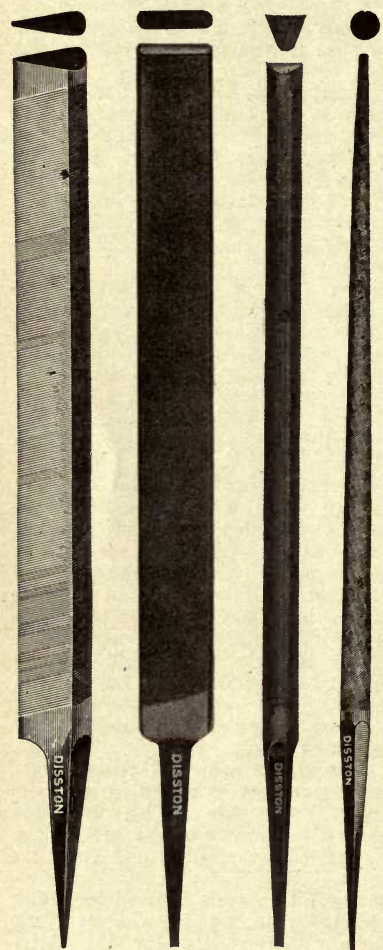
Necessity For Special Files

A very strong example of how it is necessary to make special files for special purposes is furnished by the Great American cross-cut saw file.

In this case, as well as in many others, almost any file could be used with a certain degree of success. This, and numerous other special files, however, have proved by long and extensive use that no other file can completely answer the purpose for which a special file is intended.

The popular cross-cut saw known as the "Great American" was originated, and the name trade-marked, by Disston. The special form of the teeth on this saw necessitated a file being made to suit them. This was done and it was also trade-marked "Great American."

By referring to the diagram of the teeth of a "Great American" cross-cut saw on page 45 it will be seen why this special form of file is necessary. When the file is in the spaces marked A, while filing the bevel on the teeth, it will be seen that only a wedge-shaped file like the "Great American" could be used to advantage. On the other hand, for filing the gullets marked B, a specially formed broad and rounded edge is necessary on the file.



Great
American
cross-cut
saw file

Stave
saw
file

Field's
pattern
stave saw
file

Round
file

Fig. 41.

This detailed explanation, while applying, in this instance, to one particular file, affords an insight into the causes which have made necessary so many varieties of files.

The stave saw file is somewhat similar to the mill file with two round edges. It is formed on slightly different lines, however, to make it suitable for the purpose for which it is intended—filing the teeth on cylinder saws. A special stave saw file of peculiar form is that known as field's pattern. This somewhat follows the lines of a three-square file, except that one edge is broad and rounded.

Round files are made for various purposes, such as enlarging holes, etc. These are generally tapered, but sometimes they are made parallel or of uniform diameter from heel to point. The latter are called round blunt files. A round blunt file for mill use is the round gulleting file. Owing to the tapering form of the round files, they are frequently referred to as rat-tail files.

Another gulleting file is known as the square gulleting file. This is blunt, square in form, and single-cut on four faces.

The topping file is a file similar to the mill file, but of heavier stock.

There are several files especially made for band saw use. These are along the lines of the taper file, and, in fact, taper files, regular and slim, for band saw use are regularly made. About the only difference between these and the regular taper saw files is that they have the corners or edges more rounded and have three rows of cuts. The "cut" is the same as given the regular taper file. Band saw files

include the blunt and machine band saw files. The machine file fits in a band saw filing machine which sharpens the teeth automatically. These machine files are usually about four and one-half inches in length and are made both heavy and light as shown in the illustration (page 47).

Files For Small Saws

This completes the list of single-cut files adapted to mill requirements. Single-cut saw files intended for hand saws and other small saws will now be taken up. Heading the list of these are the taper saw files. Taper files are three-cornered files, similar to the three square files, but usually smaller in length. The principal difference between them is the finishing of the edges. Taper files have the edges slightly rounded, to leave a round bottom in the gul-

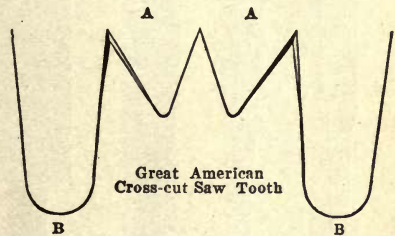


Fig. 42.

let of the tooth, and these edges are cut as well as the sides. The three-square file, which is always double-cut, on the other hand, has the edges left quite sharp, and uncut. The taper saw file is usually single-cut and is used generally for sharpening hand saws. For this

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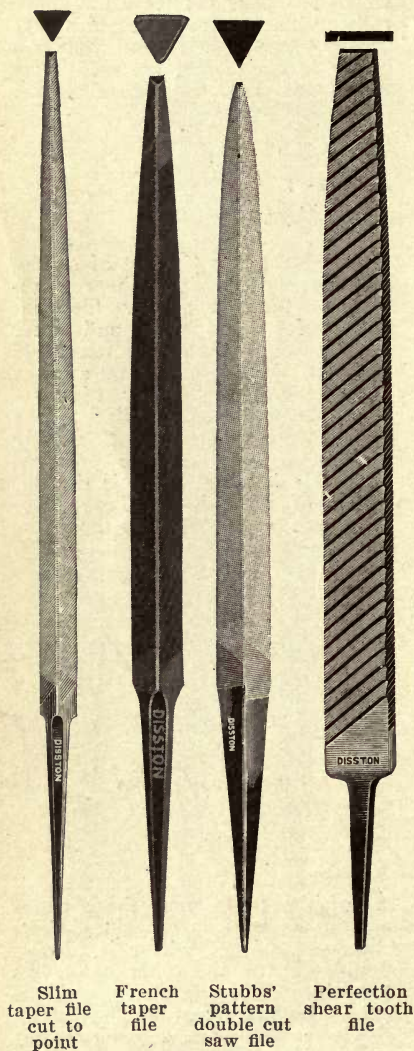


Fig. 43.

reason there is probably no other file so widely used, or so well known.

Taper files are divided into three classes: the regular taper file, the slim taper file, the extra slim taper file, and some are made extra extra slim. The slim taper files are of the same general shape as the regular taper file, but are made of a narrower section of steel for the same length. They are preferred by many on account of the greater sweep or stroke obtained from the same thickness of file. The slim taper file is particularly adapted for filing fine tooth saws.

The extra slim and extra extra slim taper are files similar to the slim taper files, but are made of narrower stock and are adapted for filing the very fine toothed saws.

A variation of the taper file is the reversible taper saw file. These files are forged tapering from the center toward both ends and are single-cut in the same way. This gives the advantage of two files in one.

Still another variation is the blunt saw file. This is triangular in form, but parallel in thickness instead of tapering to a point. It is "cut" similar to a taper file.

The Little Wonder saw file (illustration page 48) is preferred by some mechanics for filing hand and other saws on account of its special shape and the thumb rest on the end.

Hunt's chrome special three-square file is particularly adapted for filing fine tooth hand saws.

Another special saw file formed along the lines of the cant or

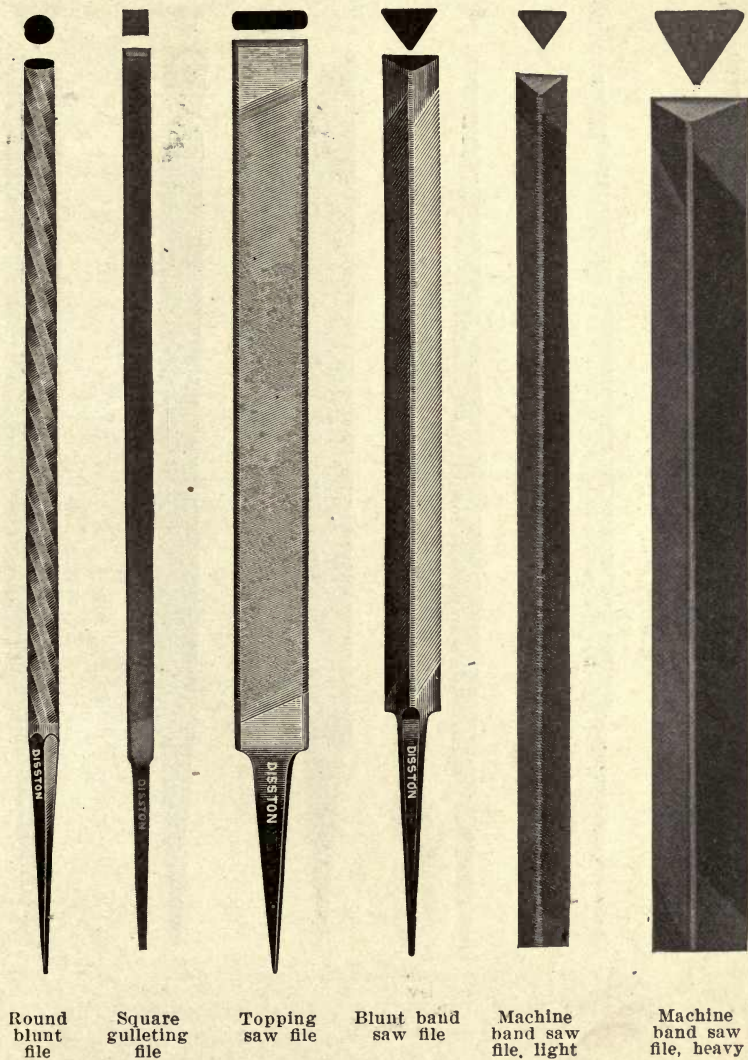
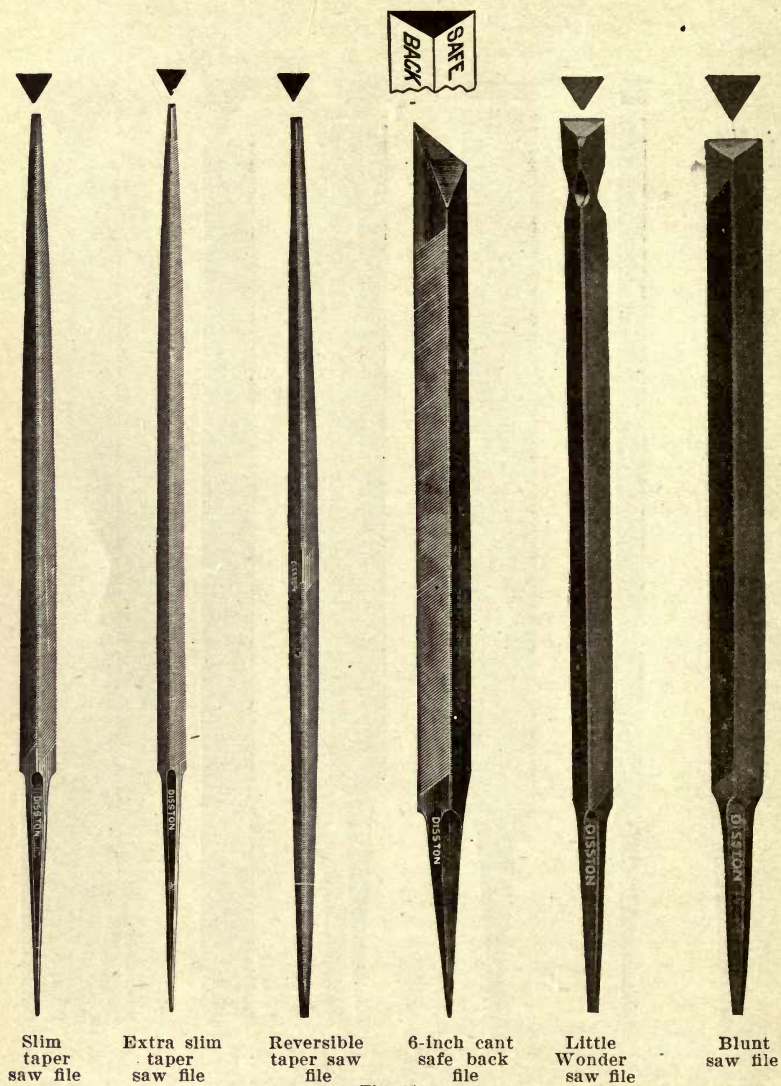


Fig. 44.



lightning is the cant safe back file. This is similar in shape, an irregular triangle, but is cut only on the broad side, the other two sides being "safe" or uncut. This file is particularly adapted for filing the Disston No. 120 Acme Hand-saw, which is specially ground and toothed to run without set.

The climax file is another file especially made for its purpose—that of filing wood saw blades and similar blades.

The two last mentioned files are of special form, and, by their use, the original shape of the saw teeth will be retained.

Before closing this description of single-cut saw files it may be well to call attention to two taper files which vary slightly from the usual forms. These are made principally for export, as there is no great demand for them in this country.

One of these is a taper file cut to the point. That is, the "cut" is carried to the extreme end, or point, of the file, instead of leaving a small portion of the point blank. This difference can be seen by comparing the illustrations on page 46 with those of regular tapers.

The other is the French taper file which is similar to the regular file in all respects save that the section of steel from which it is made is much heavier.

Double Cut Saw Files

In taking up double-cut files under the division of saw files it is to be noted that many of the forms

of files which are generally single-cut, and were described under that heading, can also be obtained as double-cut files. Mill files and taper saw files are typical of this; also, in a limited way, cant and pit saw files. While the double-cut files cut faster, the single-cut make a much smoother cut.

One of the exceptions to the rule that saw files are single-cut is the Stubbs' pattern taper saw file. This file is double-cut down to the point and is principally used for filing saws that are harder than usual, such as hack saw blades. The most noticeable difference in the Stubbs' pattern file is found in the tang and the short taper to point. Instead of having a shoulder where the body of the file usually drops sharply to the small diameter of the tang, the tang gradually tapers off with the three edges carried all the way to the point.

As practically all saw files are single-cut this description of double-cut saw files completes the list of this class of file, except those used on metal-cutting saws. Files of this nature, however, require a superfine tooth.

The next sub-division to be considered under the heading of regular files is machinists' files. These, like the saw files, are also divided into single and double-cut, but the majority are double-cut, just as single-cut predominates in the saw files. This is because the greater part of machine shop work requires fast, heavy cutting, which is only obtainable from a double-cut file. The exception is in the mill file, which is single-cut, and is used for lathe work, draw filing, and finishing.

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Taper
saw file



Hunt's
chrome
three-
square
Fig. 46.



Climax
file

The special single-cut file to be mentioned under this heading, however, is somewhat of an exception to this statement. This file is called the Perfection shear tooth file. In form, it is usually like the narrow point mill file, while its teeth are much coarser and farther apart than in the ordinary file. These teeth vary in size according to requirements, and are known as coarse, medium, or fine cut. (Illustration page 46.)

The shear tooth file is adapted for quick work on metal, such as soft steel, iron and brass castings, as well as wood and marble. It is especially valuable to machinists and for lathe purposes. In action it makes a shear cut, filing rapidly and giving clean, smooth results.

This style of tooth can be given almost any shape of file when ordered.

Quite a long list of files are found under the double-cut heading for machine shop use. The leading files for this work are hand, flat, half-round, and square for bench work, and the mill file for lathe work, as referred to before. These and the other files following are usually made in "cuts" bastard, second cut, and smooth.

Hand files are not so named because they are made or used by hand. The name is merely a technical one, designating a particular style of file. They are parallel in width, and from about two-thirds of the length taper thinner to the point, and are made with one edge "safe" or uncut. These files are used chiefly by machinists and engineers for finishing flat surfaces.

Flat files are tapered both in width and thickness, and are gen-

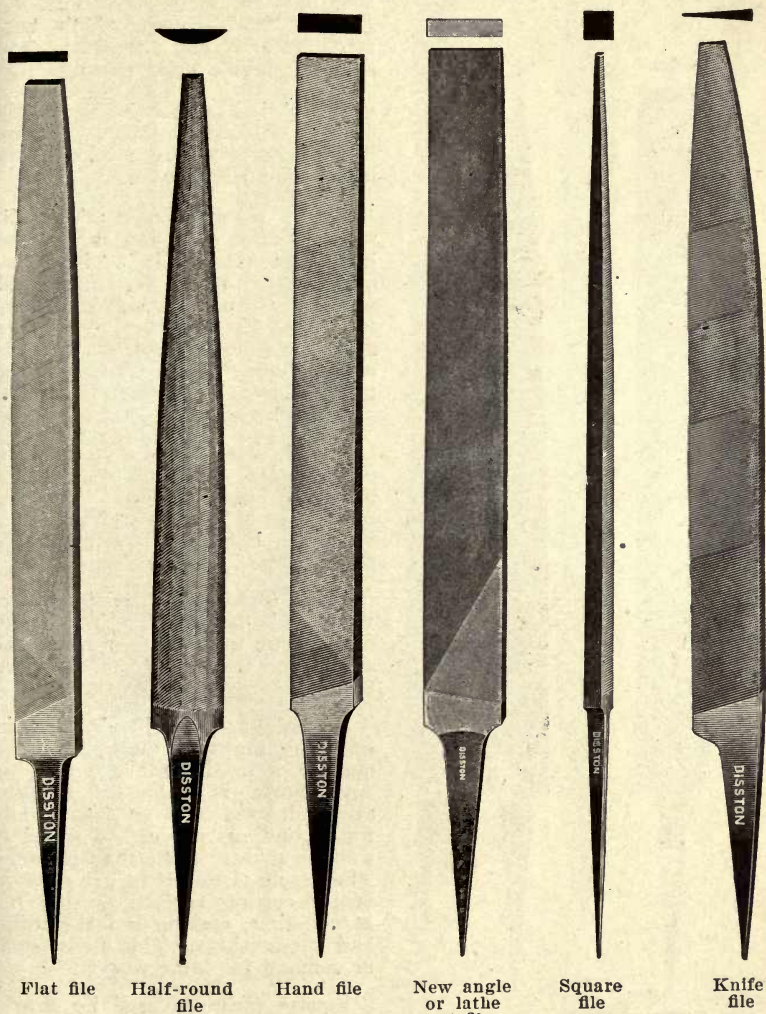


Fig. 47.

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erally double-cut on both sides and single-cut on both edges. They are sometimes made blunt in form

(parallel both in width and thickness), and can also be obtained with one or two round edges if required. Flat files are made in various degrees of "cut"—rough, middle, bastard, second cut, smooth, dead smooth, double dead smooth.

In addition to their being largely used in machine shops, flat files are in great demand by mechanics in nearly all lines of work.

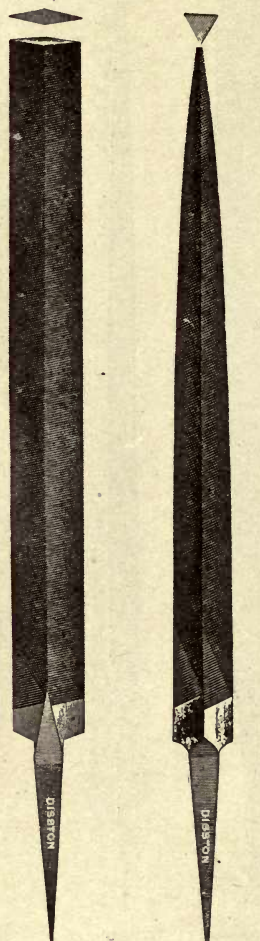
The half-round file, which divides machine shop honors with the hand and flat file, is, as its name implies, half-round in form and tapers to the point from about two-thirds of its length. This shape makes it a most useful file for general machine shop work. While usually tapered, the half-round file can also be obtained as a blunt file.

Round files, already referred to on page 45, are also largely employed in machine shops. They are chiefly used for enlarging holes. The round file in blunt form is used on the heavier class of work.

There is another special cut file, the hand bastard for brass, the first course of teeth being straight across and the up-cut more oblique than on most files.

Resembling the hand files in shape is the new angle, or lathe cut file. On this file the first, or "over-cut," is almost straight across, instead of at an angle, while the second, or "up-cut," is placed at a much greater angle than is usual. The result of this is to get a much larger cutting surface on the file at one time, making it fast cutting and fine finishing. This file is much in demand for lathe work.

Square files are used by nearly all classes of mechanics for filing apertures or dressing out square



Feather
edge file

Three-
square file

Fig. 48.



Equaling
file



Pillar
file



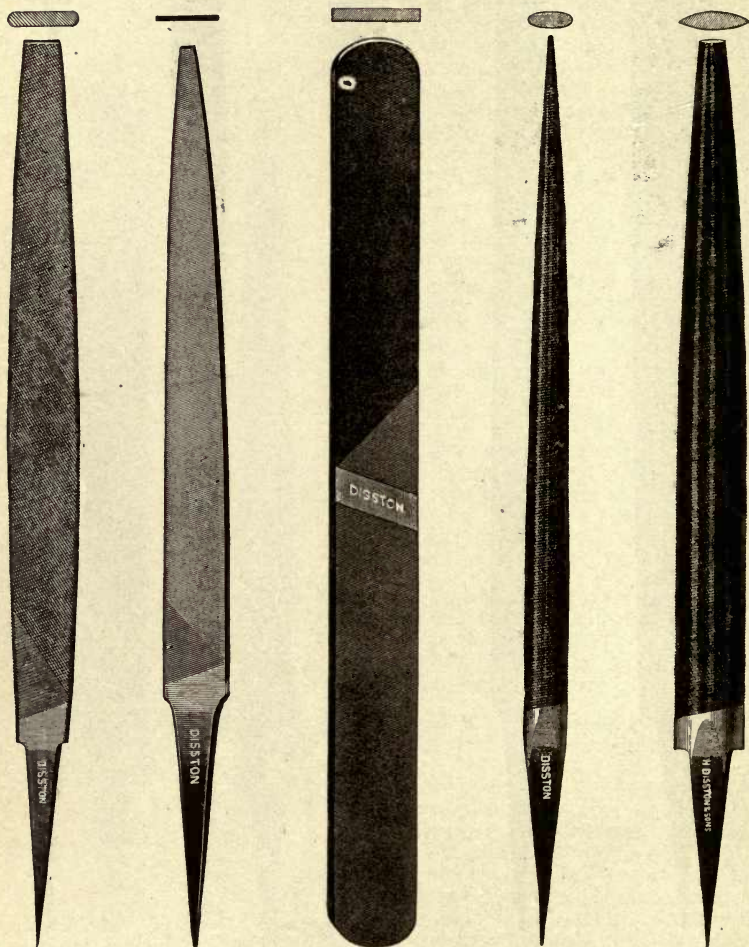
Slotting
file,
belled,
rough
Fig. 49.



Slotting
file,
smooth
cut



Taper
cotter
file



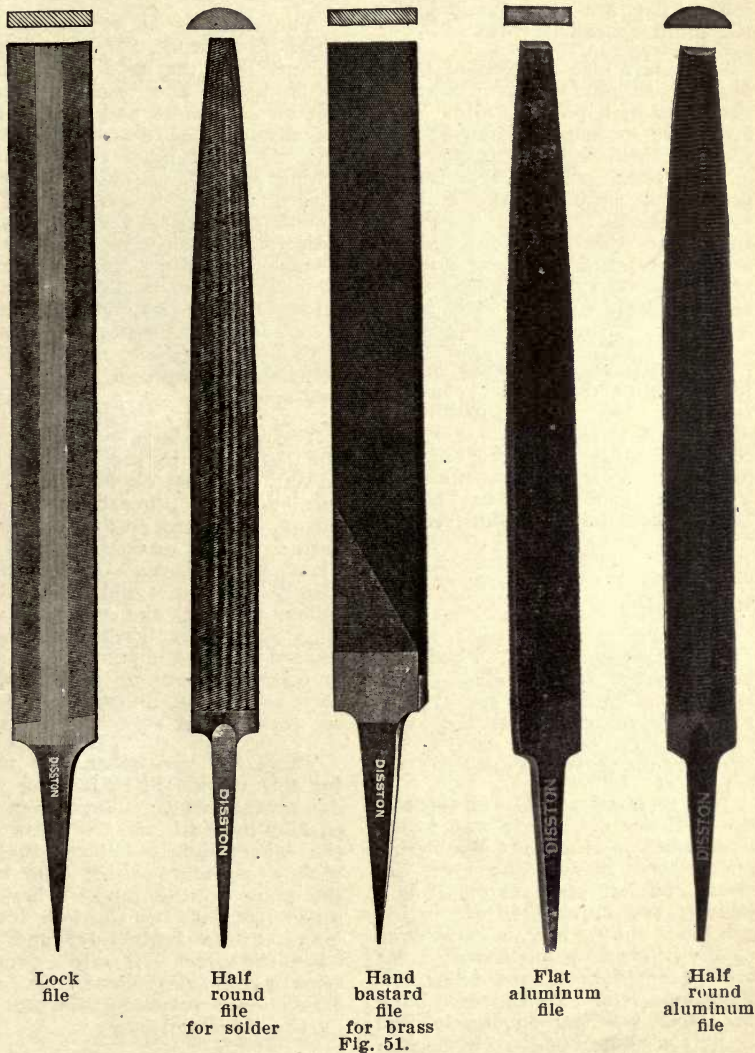
Arch
file

Warding
file

Planer
knife
file
Fig. 50.

Oval
tumbler
file

Cross
file



The File In History

corners. While they are regularly made slightly tapering on the point, they are also obtainable in the blunt (parallel) form.

The knife files are forged tapering and are quite similar in shape to the blade of a pocket knife. They are made in lengths from four to fourteen inches, but can be made in all sizes. They are usually double-cut on both sides and the upper edge left safe or uncut, the thin edge single-cut. Knife files are mainly used on metal and for special forms for which the shape is particularly adapted, such as die work, etc., having acute angles.

For purposes somewhat similar to the above the feather edge file is used. This file is parallel in length, its thickest part is in the center, tapering to a thin edge at each side. It is used for truing up V-shaped grooves, filing special shaped teeth in saws, slots, etc.

The Three Square File

The three-square file, which has been referred to on several occasions, is a three-sided file formed along the same lines as the taper saw file. Its form, in fact, is the basis for the taper saw file.

The three-square file is tapered, the teeth are cut all the way to the point, and it is always double-cut on all three sides. The edges are uncut and left very sharp. It is a popular and much used file in the machine shop, but is employed chiefly in cleaning out sharp angles and square corners, and filing cutters, taps, etc. While resembling the taper saw file so closely that a person not familiar with files might mistake one for the other, they are entirely useless as saw

files. The three-square file is sometimes made in the blunt form.

The equaling file is used in machine shop work. It is somewhat thinner than the hand file, is parallel in length and thickness and is cut on both sides and edges. It is usually ordered of a size suitable for the work intended—similar to truing up slots—and sometimes required with both edges “safe” or uncut. While used for the same purpose as a slotting file, they are considerably wider, regularly made four to twelve inches in length, whereas the slotting file ranges from ten to eighteen inches in length. They are mostly made with “cuts” bastard, second cut, and smooth.

The pillar file is one much like the hand file in section, but narrower. It is cut on both sides and one edge, the other being safe or uncut. Reference to the sections, or forms, of files on page 40 will explain the difference much more clearly than it could be written. While tapered, the taper is very slight, and only for a short space toward and on the point. It is used in machine shops on narrow work such as slotting, or cutting grooves for cotters, and keys or wedges.

There are two other files made for this work. First, slotting files, one type of which is made blunt or parallel in width and thickness, and the other slightly bellied; that is, with a curvature which runs from the point to the tang. They are made from ten to eighteen inches long, cut on both sides and one edge, the other left safe. Second, taper cotter files, narrow flat files which taper to points and are cut on the sides and edges.

The arch file is of peculiar shape, being thickest at the center,

tapering thinner to heel and to point (see page 54). It is widest at the center, slightly rounding to a narrow point and heel, and is cut on both sides and edges. Though sometimes square, the edges are usually

for locks. It can also be used for making a round hole into an oval shape.

The cross file, sometimes called the "shadbelly," is a file which is

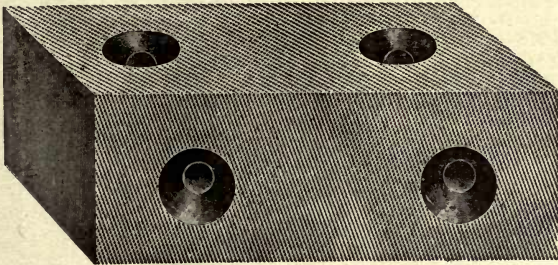


Fig. 52—Block or valve file.

rounded. It is used on work in machine shops where this curvature is desirable.

The warding file is a very thin file from four to fourteen inches in length, and is used in slotting work by both jewelers and machinists, but especially by locksmiths for putting the slots or ward notches in keys.

Files For Special Work

A sort of connecting link between single and double-cut files is the planer knife file. While it is sometimes made double-cut on both sides, in its regular form each side is half single-cut and half double-cut. This file is for sharpening planer knife blades while on the machine. This is a quicker and easier job than taking the blades out and grinding them.

A file of somewhat peculiar form is the oval tumbler. This is used principally for filing the tumblers

sometimes used in place of the half-round file, on the same sort of work. In this file both sides are rounded out, but one side, which resembles the half-round file, is higher than the other. This gives a varying curvature on the same file.

The lock file is special in form, which will be understood better by referring to the illustration on page 55, than through any printed description. The lock file is used for slotting work, mainly in connection with the making of locks and key work.

For the filing of brass and other similar metals, owing to the soft nature of the material, it is necessary to use files with teeth of special open or coarse cut. Otherwise the filings will be retained between the teeth, quickly clogging up the file and causing it to ride over the work without cutting.

The "hand bastard for brass" is specially made for the purpose. It

The File In History

has deep teeth, is a fast cutter and practically a self-cleaner. The "over-cut" is on a longer angle than usual, while the up-cut is almost straight across. This special angle cut can be furnished on any shape file desired.

A special open cut is given the "half-round file for solder," a file for soft metals, and experience has demonstrated this to be the best for the purpose.

Coming under this class also, and previously referred to, is the Perfection shear tooth file, which is adapted for quick work on soft steel, iron, brass castings, wood, marble, etc. This extra wide cut can be made on all shapes of files.

A special file for machine shop and foundry use is the aluminum file, designed particularly for filing aluminum patterns. This comes in both the flat and half-round forms.

This completes the list of files in general use for the heavier work in machine shops.

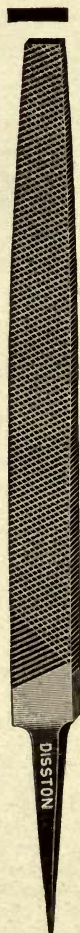
Special Shape Files

Of course, there is quite a variety of other shapes of files used by machinists and machinery builders, to describe which would require

many additional pages. For instance, there is the triple valve file, for filing sliding valve seats. This file is tanged on one end. The



Fig. 53.—"Cut" used for filing handles.



Flat wood
file



Cabinet
file

Fig. 54.



Fig. 55.—Kleen-spark tool.



Fig. 56.—Midget magneto file.



Fig. 57.—Manicure files.



Fig. 58.—Flexible milled shear tooth file.

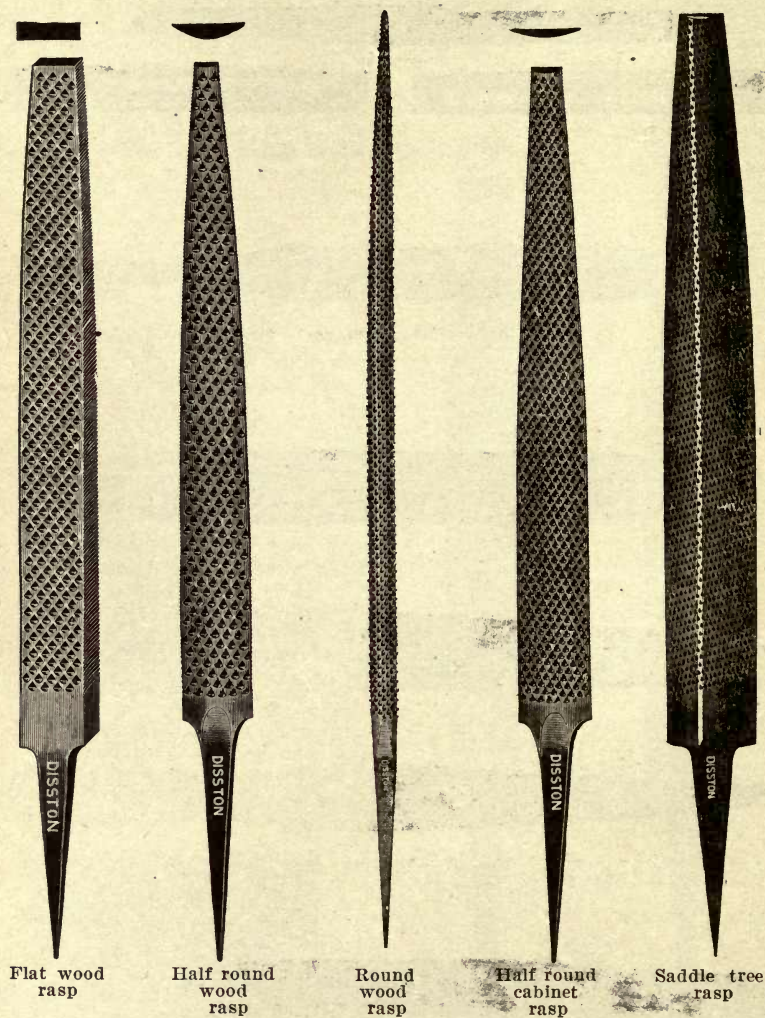


Fig. 59.

other end is forged with a shank, measuring over all $14\frac{1}{2}$ inches. It has a square body, and is made in sizes ranging from $34/64$ -inch to $1\frac{1}{4}$ inches, with a cutting surface 7 inches long. It is cut on two sides; the other two are safe or uncut. The blank is machined for the reason that files for this character of work must be absolutely true.

Another style is the valve file, an oblong block of steel, 4 inches long, $1\frac{1}{2}$ inches thick, with counter-sunk screwholes for fastening on a handle with screws.

Separate and distinct from metal-cutting files are those adapted for filing wood, but the latter do not comprise anywhere near the variety of sizes, shapes, or "cuts" as the former. The teeth in files for wood are widely spaced, but are not as coarse as those for filing soft metal.

Files for Woodworking.

In woodworking there are three shapes of files principally used, the flat, half-round, and the cabinet.

The flat wood file is formed on practically the same size blank as the flat file for metal, but naturally, owing to the softer nature and fibrous character of wood, the teeth for these files are larger and more widely separated. It is double-cut on the sides and single-cut on the edges. This file is mainly used for finishing after the rasp has done the preliminary work.

The half-round wood file is the same as a regular half-round file, except for a difference in the "cut."

Excepting that it is somewhat wider and thinner, the cabinet file is similar to the half-round, with slightly finer teeth.

Worthy of special mention in the group of woodworking files is the 14-

inch half-round saw handle file, with special cut.

This particular style of file was used by some of the older men when in England, where they learned their trade. When these men came to this country, they brought this file with them. It has been used in the Disston Works ever since.

The cut is what may be termed "float-cut." It is widely spaced, has very sharp cutting edges, as shown in the illustration on page 58, and the particular shape of the teeth makes possible an easy, very rapid, smooth shearing cut.

Referring again to metal-cutting files, the comparatively new but stupendous business—automobile manufacturing and repairing—led to the making of a number of special files. First among these came the spark plug file which is similar in shape to a manicure file. The "Kleen Spark" is a tool which is a combination of knife and file. The end of this file is chisel-shaped for cleaning gummy, oiled surfaces. The magneto file, and its small brother, the midget magneto file, complete the group.

These are used to clean spark plugs on engines, magnetoes, ignition coils, contacts, etc., and are of a thickness allowing them to be used as a gauge in obtaining the proper spacing between the points of a spark plug.

In the building of automobile bodies there is a special file used termed flexible milled shear tooth file. This is fastened on a wood handle, the file itself being 14 inches long, $1\frac{3}{8}$ inches wide. The teeth, 10 or 12 to the inch as required, are milled in, making them strong and sharp. This is used for fast filing of soft metal.

The File In History

Entirely different in use is another group of files, manicure files, which need no special explanation. These are made in a variety of styles and sizes—the light flexible, heavy flexible, files with cleaner point, with diamond point, plain point, cutter point, double end file with pencil sharpener, etc.

Belonging to this group is the corn rasp, of which mention is made further on.

Along a somewhat similar line is the corrugating file. These are made in several degrees of cuts and are used to corrugate the blades of barbers' shears, to prevent the hair from slipping when being cut.

Rasps, Different From Files

While always considered under the general head of files, rasps are really in a class of their own. The principal difference, of course, is in the teeth, which are detached, that is, not run in a continuous line, and not formed like the teeth on single and double-cut files. As described on page 39, instead of being cut with a chisel, rasp teeth are raised with a punch. They are much higher than the ordinary file teeth, set well apart, and staggered. In this manner they are enabled not only to cut uniformly, but very quickly; each tooth taking a larger "bite" than the ordinary file teeth.

There are several different styles of rasps, each used for different purposes. They are all so important in their respective lines that it would be hard to say positively which variety takes precedence over another.

Probably the most widely used of

all rasps, however, are those for wood. These are employed by wheelwrights, carriage builders, plumbers, cabinet, saddle-tree, pattern and last makers, gunstock makers, and fine woodworkers generally.

Flat wood rasps are forged similar in form to the flat file. This kind of rasp is single-cut on the edges, with punched teeth on the sides.

The half-round wood rasp is formed like a half-round file, but has punched teeth on both the flat and round sides.

The round wood rasp is used by cabinet makers, and for other wood-working purposes. It is round in form, with punched teeth clear out to the point. It is interesting to compare the illustration shown of the modern round rasp with the pictures on page 8 of the ancient Egyptian rasp. In the case of this particular rasp the changes which have taken place in the intervening thousands of years appear to be very slight. The round rasp is frequently used for other kinds of wood-working in addition to cabinet work.

Another rasp for woodworking, and intended especially for cabinet work, is the cabinet rasp. This is a half-round rasp, but thinner than the regular half-round rasps and files. This rasp is punched on both the round and flat sides, and has the edges single-cut.

The saddle-tree rasp is another special half-round rasp which is used in the manufacture of saddles. This resembles the cabinet rasp just described except that the teeth are slightly larger and set a little farther apart. The teeth are cut in rows running obliquely across the rasp. The edges are not cut.

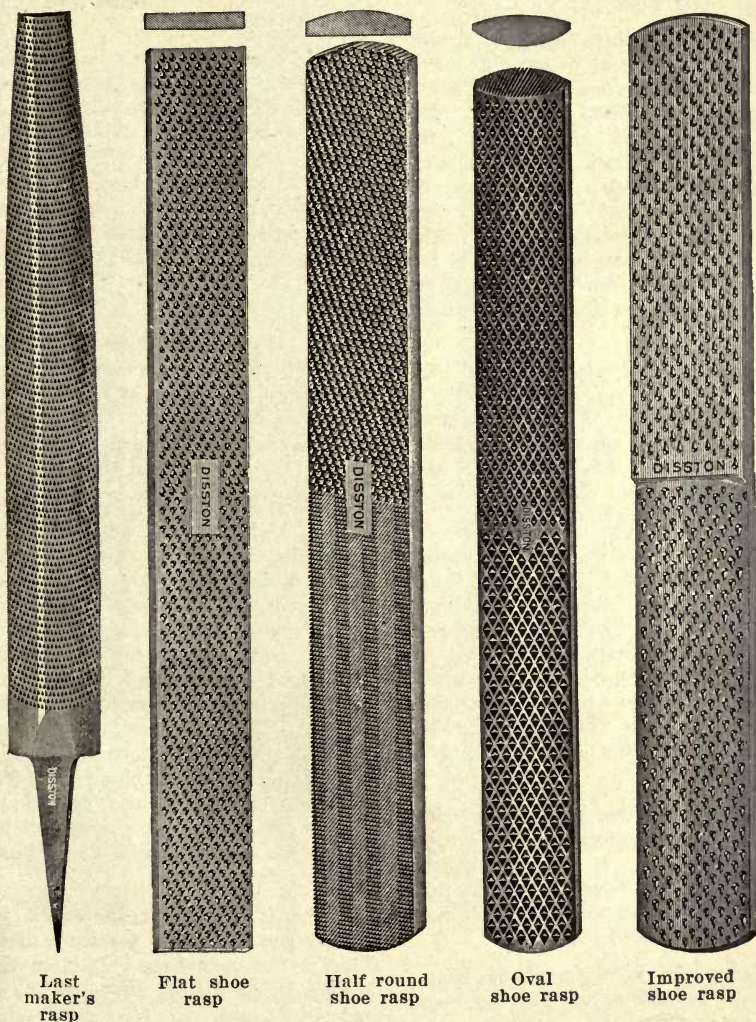


Fig. 60.

The File In History

The great shoe industry, one of the largest in the world, has several rasps made especially for its use.

The last makers' rasp is a rasp used in the making of the lasts upon which shoes are made. It is similar in many respects to the cabinet rasp described above, except that the edges are very thick and not cut; and the rows of teeth are cut on curved lines. The flat shoe rasp has parallel sides and square ends. The sides only are cut. Beginning at the center, the teeth run in opposite directions. It is used for filing the soles of shoes.

Another rasp used for both the soles and heels of shoes is the half-round shoe rasp. This has punched teeth on half of one side and double-cut teeth on the other half. It is also cut on the ends. This rasp is most in demand in the United States.

The oval shoe rasp is half-round on one side, and slightly rounding or bellied on the other. This affords two surfaces of different curvature, making them especially useful in forming the heels on shoes, for which work they are principally used. This is another rasp that is cut on the ends, but in this case the end is beveled.

A shoe rasp that is used altogether abroad is the improved shoe rasp. This rasp has a shoulder at the center, one-half being thinner than the other. The teeth on each half run in opposite directions.

Rasps are widely used by horse-shoers, several patterns being made for their special use.

The plain horse rasp is of

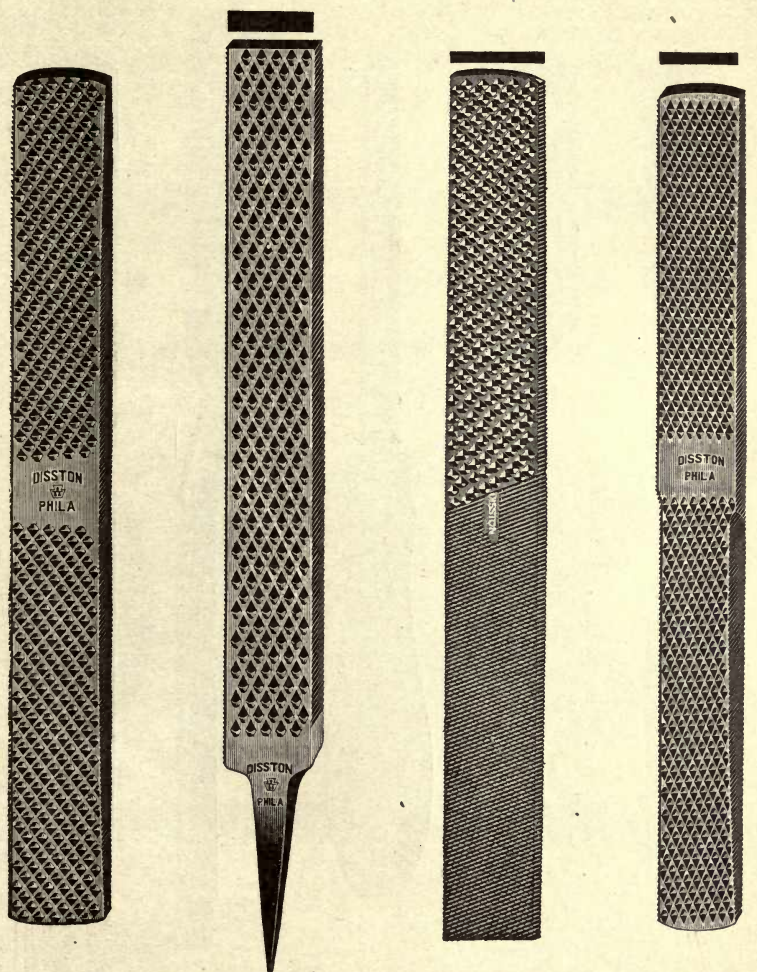
parallel form, single-cut on the edges, and rasp-cut on each side with the teeth running in opposite directions from the center.

The tanged horse rasp is of the same form, but has a tang on one end, and the teeth all run in the same direction—away from the tang. The regular horse rasp is parallel in shape, with one end square and the other slightly rounded. The edges are single-cut, while the sides are rasp-cut on one half, and double-cut on the other. The teeth are cut from each end to the center.

The beveled edge horse rasp has the teeth running in opposite directions from the center, and each half is beveled on the opposite sides. The edges, including the bevel, are single-cut.

Blacksmiths—or farriers—and veterinary surgeons, both use what is called a horse-mouth rasp in dental work on horses. This consists of a long handle (some have a screw joint in the center for compact carrying) with a short rasp at the end. This also comes in a slightly different form known as the horse tooth file and rasp. In this case there is an adjustable holder at one end in which is secured a short combination file and rasp called a float. This float is rasp-cut on one side and double-cut on the other. It is held in place by two screws.

There is another rasp which is usually classed among manicure files. This is the corn rasp. It is made in various sizes from 2½ inches to 6 inches in length, and is very light in weight. It is a double-end rasp, with a curved depression on each side at



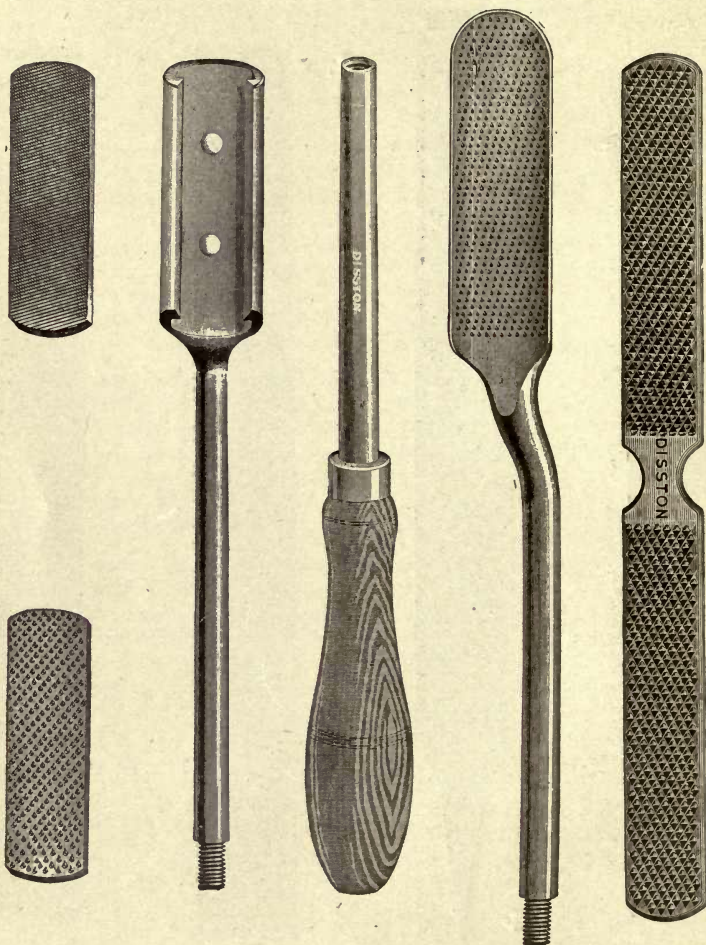
Horse rasp,
plain

Horse rasp,
tanged

Horse rasp,
one-quarter file

Horse rasp,
beveled

Fig. 61.



Horse tooth file
and rasp with
adjustable holder

Horse tooth
rasp and
handle

Corn
rasp

Fig. 62.

the center, where a grip is obtained with the thumb and forefinger.

Riffler Files

The next in order are riffler files, that is those rifflers which are given

the regular file and rasp cuts. Rifflers are also made with superfine "cut," which will be taken up with other files under that class.

Regular rifflers are usually double-ended with curved working surfaces

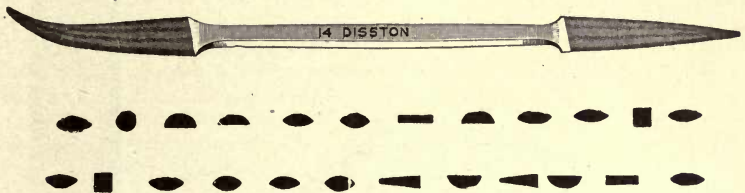


Fig. 63.—Regular rifflers.

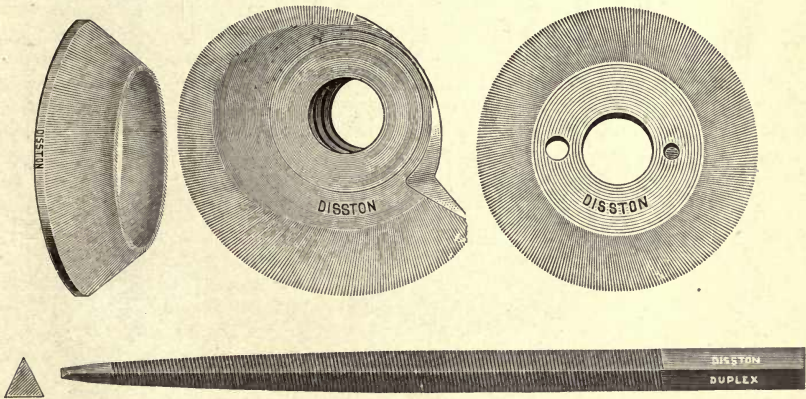


Fig. 64.—Gin saw files.

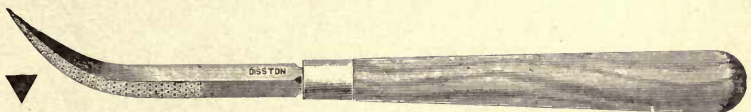


Fig. 65.—Bent riffler file.

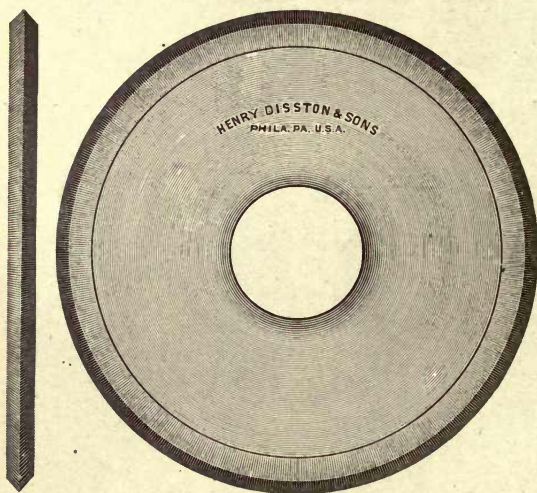


Fig. 66.—Circular and straight files, for filing
beet shredder knives

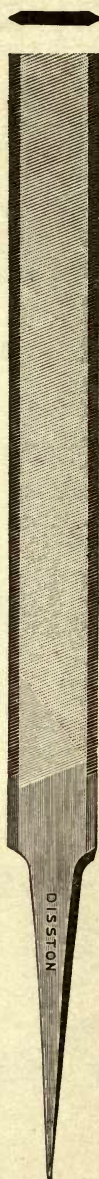


Fig. 67.—Double bevel file.

and a smooth center for handhold. They are made in various lengths, shapes, and cuts, and are generally used on sculpture for stone and wood carving, by toolmakers and diesinkers for dressing indented or depressed surfaces.

While all rifflers are bent or curved, there is another group which for the sake of distinction is termed bent rifflers. These are furnished with wood handles, as illustrated, and are principally used for filing cavities. They are usually furnished in sets of six assorted shapes, either file, rasp, or superfine cut.

In the ginning of cotton, by which process the seeds are removed, a gang or number of small circular saws are used in each machine. These saws have teeth of peculiar shape for the sharpening of which a special pattern of circular file is used. There are a number of different machines made for the purpose, each requiring its own particular shaped file, of which we illustrate three patterns.

In addition to the above there are several patterns of straight files used—one is knife-shaped, others triangular, or like the tapered file shown on page 67. These are made of any thickness or cut desired.

Another class of files is that used in the beet sugar industry for the sharpening of beet slicing knives or shredders, as they are sometimes called, which have serrated edges.

The straight files for this purpose are made in the forms of square, hand, and equaling—some with double

beveled edges and of special "cut." They range from three to five inches long and are tanged on one end.

Circular files cut on edge are also used for sharpening of these knives. They are made of any size, thickness, or shape of edge to suit the knives in use.

Superfine Files

The next division in the listing of files comes under the head of superfine, by which is designated that group having extremely fine teeth. These include a long range of varieties, running from the tiny files used by watchmakers and jewelers—on many of which the teeth are so fine that the files feel almost perfectly smooth to the hand—to the comparatively large and heavy files with the superfine cut, used for finishing work in machine shops.

They were originated in Switzerland or France, the records at hand pointing more strongly to the former, and were used especially by watch and clock makers and by manufacturers of machinery and dies for this delicate class of work.

On page 70 are shown illustrations of the various superfine cuts. These begin with what is termed the No. 00 cut and run down in fineness to that known as No. 8.

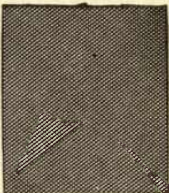
The majority of the larger superfine files are shaped in a manner similar to the regular files which have

The File In History

The different cuts of superfine files



No. 00



No. 0



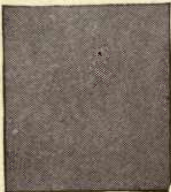
No. 1



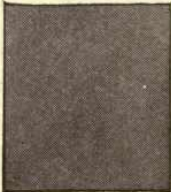
No. 2



No. 3



No. 4



No. 5



No. 6



No. 7



No. 8

Fig. 68.



Flat
file



Crochet
file



Barrette
file
Fig. 69.



Slitting
file



Drill or
joint file

The File In History

Shapes of needle files

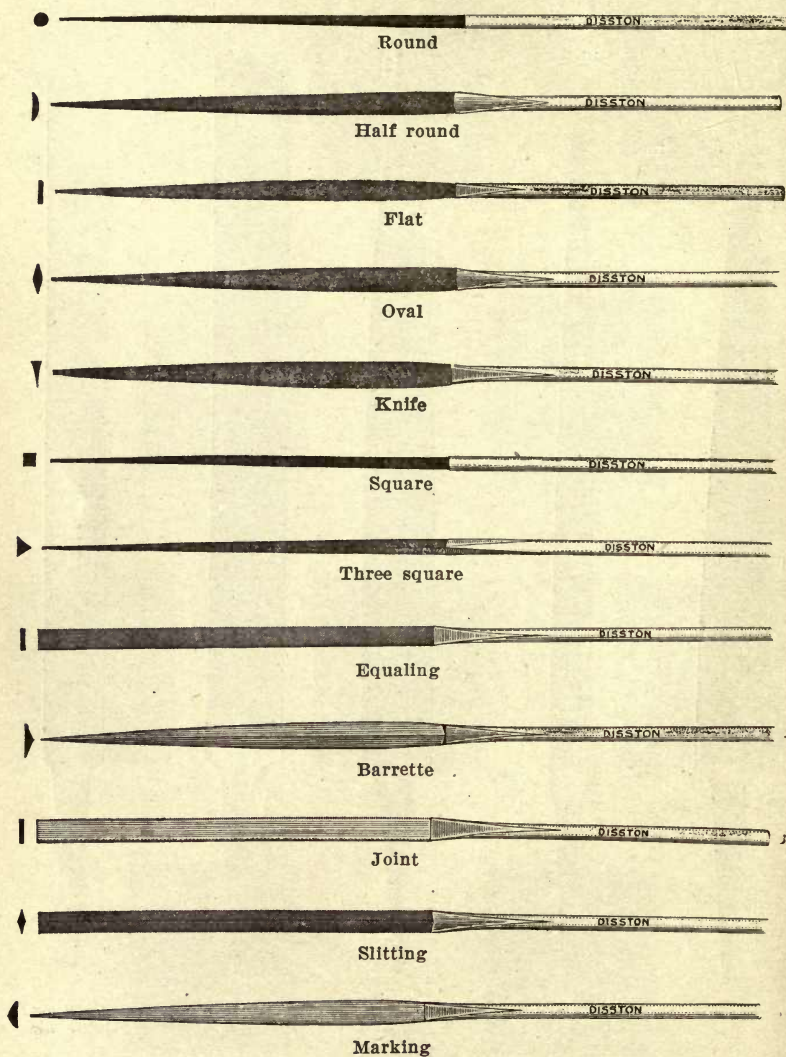


Fig. 70.

Escapement files

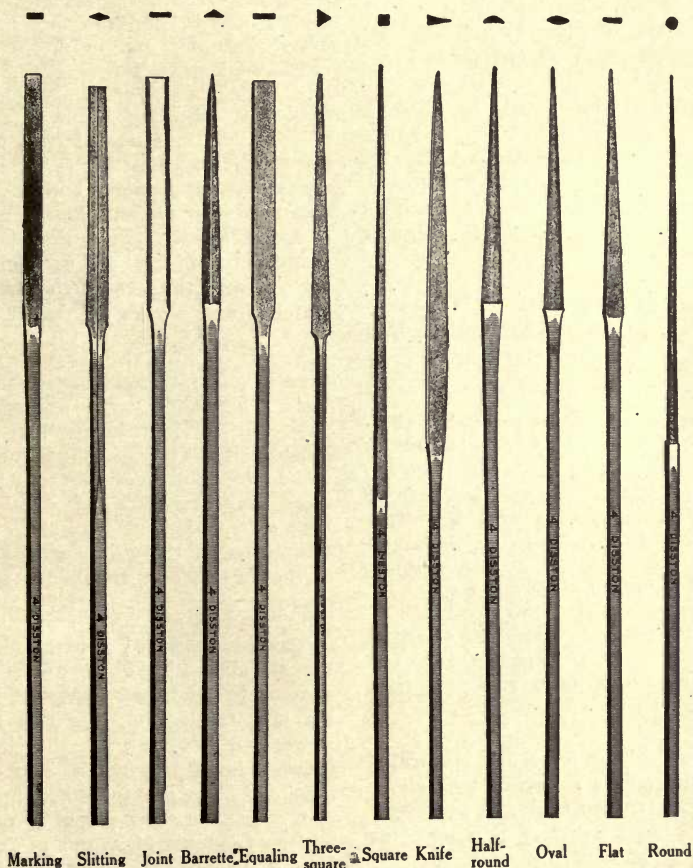


Fig. 71.

The File In History

been described throughout this article. This makes it unnecessary to illustrate more than a few which show slight variations from these standard forms. The principal difference lies in the "cut" or teeth, which can be seen readily by comparing the illustration of superfine cuts shown here with the standard cuts of regular files shown on pages 37 and 38.

The flat file, it will be noticed, differs from the shape of regular files by tapering to a point, which also applies to the round, half-round, square, etc. Other forms, such as hand, pillar, etc., follow the regular shapes.

A file of peculiar shape is the crochet file. This has both edges rounded and cut, and tapers to a point.

The barrette file is somewhat similar to the three-square file, but is more flattened in form and is generally cut on the wide side, left safe or uncut on the two narrow sides. This file as well as the one above is employed for filing on any fine or close-fitting work, like die-making.

The slitting file is diamond shaped; that is, wide at the center and tapering to a thin edge on both edges.

The drill, or joint file, is parallel in width and is furnished with either round or square edges, as preferred. As the name indicates, it is used for filing drills.

These constitute the large superfine files and range from two to twelve inches in length.

Needle Files

Needle files are small, slender files from four to six and a quarter inches in length (measured over all), and are made in all the different forms. Only half the length is cut, however, the balance of the file being formed into a long, round tang or handle. These little files are used for jewelers' work principally.

Closely following the needle files in form and in shape of ends is the group of escapement files. These are usually five and one-half inches long measured over all, and are made with a square handle. They derive their name because they are used chiefly for filing the escapements for watches and clocks.

A few additional files which are used by clock-makers are the screw-head file, made with or without tang, two to four inches long; the balance file, ratchet, right hand, and the double-end pivot files, the latter being made right or left "cut" and with either sharp or conical corners. The forms of these files will be seen in the illustrations, which are actual size.

Another group of straight files is the die sinkers'. These are similar in form to the larger superfine files; but are usually made in two sizes, three, and three and a half-inches in length, formed with a tang for handle. They are furnished in sets comprising the same shapes as needle and escapement files, and in "cuts" Nos. 0, 1, and 2. The name implies their use.

A special file that has attained a more or less standard form is the

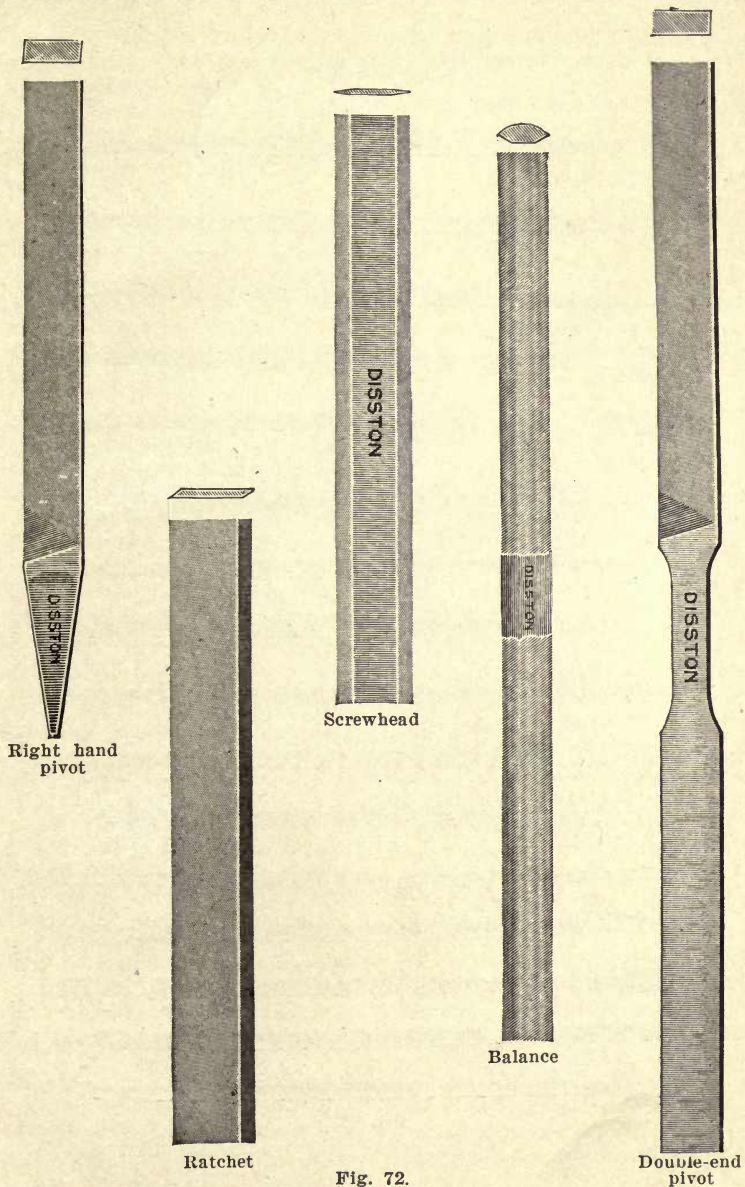


Fig. 72.

Special rifflers

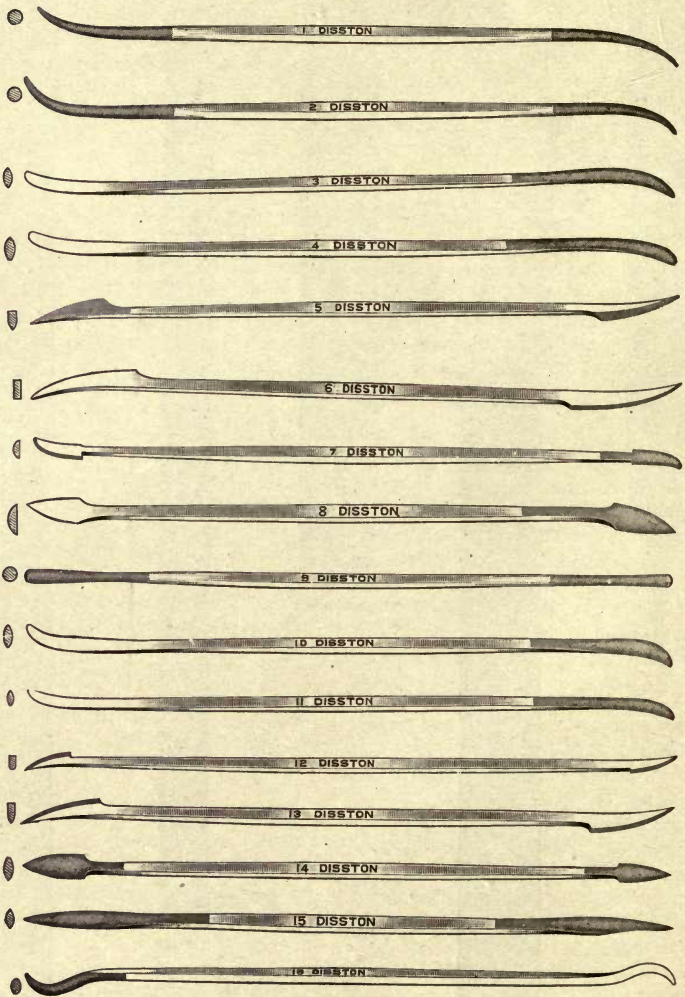


Fig. 73.

riffler, used by sculptors, silversmiths, die sinkers, etc. This form consists of a long, straight center for hand hold, while the ends for a short distance are file cut. The chief variation in these matters lies in the shape of the end and size.

These are made in three sizes, large, medium, and small. The medium size is illustrated in reduced length—the regular length for each being six and one-half inches. They differ only in the thickness of the stock.

The individual types are too numerous to reproduce here, but a very good idea of the sizes and general forms may be had by comparison of the regular rifflers shown on page 67, which are eight inches long, with the special rifflers, which are slender in stock and about six and one-quarter inches in length. The illustration being about three inches less than actual size.

Slightly longer than the above, but considerably heavier in stock, with more cutting surface, are the French rifflers, the set composed mostly of rasp-cut from fine to coarse.

Coming next in size and in greater variety of shapes are the die sinkers' rifflers, which are seven inches long and somewhat heavier in stock.

Then follow the silversmiths' rifflers. These are seven and a half inches long and narrower on the cutting ends.

There is also a form of riffler that has but one end curved, shaped and cut, the other end being formed into a tang to fit in a wood handle. This

is the style previously referred to as the bent riffler.

The bench filing machine files differ from the files just described in that they are especially adapted for use in power-driven machines.

They are made in a variety of shapes as shown on page 78; and with cuts Nos. 00, 0, 1, and 2.

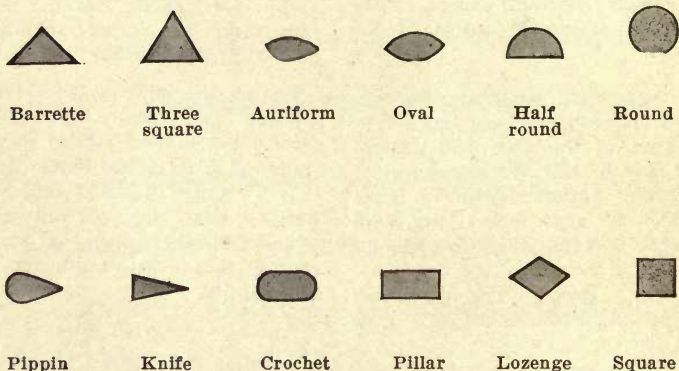
Similar as to shapes, but longer and wider, are the parallel machine files, which are formed with a tang. These are made in all "cuts."

During the late war the House of Disston manufactured for use on glass tubes in laboratories over fifty thousand glass files. These files are now a regular product. One style is flat, 2 inches long, cut only on one edge. Another style is 3 inches long, 3 square with teeth cut on the edges only.

Another group of files is the kit for filing shoe machinery. This kit consists of twelve blunt files, $3\frac{1}{2}$ inches long. These files are: 1 equaling file with two safe edges, 1 equaling file with one safe edge, 1 equaling with both edges cut, a large and a small square file, a large and a small slitting file, one scoring file, one screw-head file, one joint file, one ratchet file, and one square edge joint file.

To name the industries in which files are used would be almost like compiling a trade directory of the world, for there are few that do not need some form of file. This gives rise, of course, to a number of special shapes that are invented and manufactured to meet the peculiar needs of some particular line of manufacture.

Fig. 74.—Bench filing machine files.



It would be impossible to show all of the various forms of special files, and needless, too, because many are turned out to meet certain conditions, or as experiments.

This brings to a close the story of the file from the time when history first recognized its existence, down to modern times when its use has become indispensable to almost every form of manufacturing business. Al-

though many foreign countries still manufacture files, America long ago took the lead in production.

In addition to using annually over 35,000 dozen files of their own manufacture in their saw works, handle factory and machine shops, The House of Disston sends enormous quantities of their files, not only all over this country and Canada, but to almost every country in the world.



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